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ABSTRACT

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair. Fairs operate on a step basis. Students who win in small fairs such as a local fair, move to a city fair, then to a regional fair, and may be chosen to represent that fair in the International Science and Engineering Fair (ISEF). The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 36th ISEF in Shreverport/Bossier City, Louisiana in May, 1985 as the result of being chosen the best in 334 affiliated fairs. Abstracts are organized by project categories. These 13 groups are described and include: behavioral and social sciences; biochemistry; botany; chemistry; computer science; earth and space sciences; engineering; environmental sciences; mathematics; medicine and health; microbiology; physics; and zoology. An index is also included of all the finalists. (ML)

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ABSTRACTS

36th International Science and Engineering Fair

Abstracts of the Finalists

of the

International Science and Engineering Fair

held in

Shreveport/Bossier City, Louisiana

May 12-18, 1985

SCIENCE SERVICE
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PREFACE

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair.

The purpose of fairs is threefold: to stimulate in young people an active interest in science and engineering; to provide an educational experience through being exposed to the judges and to the public; and to give public recognition to talented students for the work they have done.

Fairs range in scope from the local level, which may involve one class, or one district, to ones which may involve a large city, a county, a state, or even a nation. While there are no exact figures, it is estimated that over one million student projects are undertaken each year in the United States, and that there are fairs in more than twenty other different countries.

Science and engineering fairs operate on a step basis, with students who have won in small fairs participating in large fairs as representatives of the fairs in which they have previously won. Thus, an individual might participate in a local fair, move to a city fair, then to a regional fair, and be chosen there to represent that fair in the International Science and Engineering Fair.

The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 36th ISEF in Shreveport/Bossier City, Louisiana in May 1985 as the result of being chosen the best in 334 affiliated fairs.

Science Service, the nonprofit institution devoted to the public understanding of science, which conducts the International Science and Engineering Fair, pays tribute to these finalists, to their teachers, and to the thousands of individuals and organizations who made possible the presence of these ISEF finalists in Shreveport/Bossier City.

We wish to thank the General Motors Foundation for the funds which supported the printing of this book.

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#MEMORY: CAN IT BE ENHANCED BY SUPPLEMENTARY SENSORY AIDS?

Swarthout, Brenda L., Hildreth High School, Hildreth, NE 68947
R.R. #1, Hildreth, NE 68947

During two years of study, 113 elementary students were tested. Three stages of the project were developed to refine the hypothesis that sensory aids will enhance a child's ability to remember and recall information.

Each study allowed an equal time allotment procedure. Each equal ability group was chosen according to reading level and was tested independently from eachother. First, 39 students were divided into two groups. The material to the control was presented strictly as fact. Rhyme, music, and color were incorporated with group two's lessons. A second analysis used 36 children to determine the relative effectiveness of color, rhyme, and music. The third refinement of the project dealt solely with color as a learning aid. Thirty-eight students were tested in this study. A set of three tasks included reading comprehension, math, and spelling skills. The first group learned their lessons using their favorite colored marker on white paper. The second used black marker on colored paper, and the third used pencil on white paper.

In the first study, the group learning with rhyme, music, color did an average of 48% better than the control using no aids. The second refinement showed that color was the most beneficial of the three aids. In the third study, the group applying color to white paper answered 78% if the questions correctly compared to 77% correct answers from the group using black on color. The group using pencil to complete their lessons answered only 55% of the questions correctly.

Therefore, learning aids are beneficial, color is the most beneficial of the aids, and colored markers on white paper was the most effective way to utilize color.

#First Award - Allegheny International, Inc.
First Award - General Motors ISEF
Second Award - American Optometric Association and the Auxiliary to the American Optometric Association

#PREMENSTRUAL SYNDROME: CAUSES, EFFECTS, AND POSSIBLE PREVENTION BY THE USE OF VITAMIN B-6

Browning, Cassandra A., Nicholas County H.S., Carlisle, KY 40311
Route 4, P.O. Box 174, Carlisle, KY 40311.

Premenstrual syndrome is a condition described by many women prior to the onset of menses. Research indicates that there are factors common to most sufferers; physical and behaviorial changes, an increase in prolactin levels, and lowered concentration performing basic skills. This project involved one treatment of P.M.S., Vitamin B-6, on fifteen women.

Questionnaires were used to determine severity of P.M.S. symptoms before and after treatment. Another abnormality checked was the prolactin level of blood. Blood tests were analyzed during non-treated and treated P.M.S. Finally, cognitive skills tests were given at both times to test basic skills.

After gathering results it was determined that there are definite symptoms of P.M.S. Some of the women displaying P.M.S. did have an elevated prolactin level. After treatment, women reported a decrease in observed symptoms on questionnaires. About 63 percent scored better on cognitive skills tests, while 75 percent had a decrease in prolactin levels. According to this research Vitamin B-6 seemed to provide a positive affect on P.M.S. sufferers.

#Fourth Award - General Motors ISEF

#INTERACTION VS. BACK-UP: TESTING TWO THEORIES OF MOUSE NAVIGATION

Wood, Ann Marie, Bell Junior High School, San Diego, Calif. 92139
5021 Tierra Baja Way, San Diego, California 92115

An experimental study was made to determine if mice used a magnetic field cue as back-up to visual cues, or if magnetic cues worked interactively with visual cues during navigation of a T-maze.
Procedures:
1. A sequential reversal design, $A_1B_1A_2C_1A_3BC_1A_4BC_2$ was used. Six trials were in each condition.
2. A_1, A_2, A_3, and A_4 were control conditions. All subjects (20 mice) ran the T-maze without help from sensory cues to locate food rewards.
3. There were three experimental conditions. All 20 mice participated in all experimental conditions. In B_1 a visual cue was used alone. In C_1 a magnetic field cue was used alone. In both of the BC trials both visual and magnetic cues were used.

In each condition of the experiment the results pointed in the direction of my hypothesis. The percent success increased from A_1 to B_1 and the difference was significant at .05. The percent success increased from A_2 to C_1 and the difference was significant at .05. The percent success increased from A_3 to BC_1 and the difference was significant at .01. The percent success increased from A_4 to BC_2 and the difference was significant at .01.

To test for interaction I used the T-test with a comparison between B_1 and the BC trials. The results were not significant at .05. A test for interaction was used. I found that there was some evidence for interaction, especially among a sub-sample of mice.

In summary, results point toward interaction but did not reach a .05 level of significance.

#Third Award - General Motors ISEF
Honorable Mention - American Psychological Association

MORALITY IN CHILDREN

Nine, Susan M.; Gage High School; Gage, Oklahoma 73843
Rt. 2 Box 43; Gage, Oklahoma 73843

A Study of Moral Judgments and Performances of Elementary Children in Ellis County, Oklahoma.

Children were selected from the first and third grades. One at a time they were put into a room where a bowl of candy and a bowl of raw vegetables were placed in front of them. They were told they could eat as much vegetables as they wished but could not have any of the candy. The child was then left alone for one minute and secretly observed.

After the observer re-entered the room, the child was told two stories. One story was about a person who stole and was caught. In the other story the person got away with stealing. The child was then asked his judgments about the stories.

All the children agreed it was wrong for children in both stories to steal. None of the first graders took any of the candy but two of the third graders did. Both age groups mostly agreed the boy who got caught was naughtier because he stole from a store; however, a few disagreed with this.

Children act differently since they are in different stages of moral development. First graders want to obey adult rules because they feel rules are unchangable. They also want more severe punishment for a wrong act. Third graders make more of their own decisions and see themselves as equals with older people. They want milder punishment that helps them realize what they have done wrong. Parents are strong models for children's behaviors.

There is a difference between moral judgments and moral behavior performances.

#COLOR PERCEPTION: A STUDY ON THE INFLUENCE OF CONNOTATIVE LANGUAGE CLUES ON COLOR PERCEPTION

Creech, W. Jeb., Bismarck High School, Bismarck, North Dakota 58501
619 N. 6th Street., Bismarck, North Dakota 58501

Many scientists disagree how anatomy, psychology, and physiology work together in color perception. The purpose of this project is to study color perception and to present an original experiment that will determine an interplay of psychological and physiological factors.

If psychological and physiological factors combine in color perception, color is not only in the eye, but also in the mind of the beholder.

A chart containing five shades of the colors blue, green red and yellow was shown to a control group of 100 students, after being given the Ishihara Test for color blindness. The subjects were asked to select by number the truest shade of each color, the shade that received the second greatest number of the control group choices was labeled with a word that strongly connoted that color, was shown to an experimental group containing 100 students matched to the control group by age and sex. These subjects were tested for color blindness and were asked to indicate by name the truest shade of each color. All subjects were asked to complete a questionnaire designed to indicate the association of the word with color.

#Third Award - General Motors ISEF

#SOCIAL AND INDIVIDUAL OBSERVATIONS OF ORANGUTANS IN CAPTIVITY

Hunt, Mandy, Denis Morris High School, St. Catharines, Ontario, Canada;
1 Allandale Drive, St. Catharines, Ontario, Canada.

No abstract received.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

#EIDETIC IMAGERY: KIDS SEE THE DARNEDEST THINGS

Hilliard, Stephen M., Herando H. S., Brooksville, Fl 33512
1520 Arnold Ave., Brooksville, Fl 33512

Eidetic Imagery, the ability to retain images of photographic clarity by glancing briefly at a picture, is a little known area of psychological research. It is frequently grouped with another phenomenon known as "photographic memory". Eidetic Imagery has been shown, in some studies, as being prevalent only in young children.

The hypothesis of this project was to determine the frequency of eidetic capabilities in a random population of school children, ages 10 to 13. It was also the intent of this project to determine whether eidetic capabilities contributed to a consistent response in the students' most favored school subject.

Although 10 per cent of the children tested exhibited this particular type of imagery, no direct correlation between the eidetic imagery capability and favored school subject could be developed.

In addition, although photographic memory and eidetic memory are similar in nature, it is the opinion of this researcher that they are separate and distinct phenomena, and should be researched independent of each other.

#First Award - United States Army
Second Award - General Motors ISEF
Honorable Mention - American Optometric Association and the Auxiliary to the American Optometric Association

#CAN THE PSYCHOLOGICAL EFFECTS OF A TOUCH-SURROUNDED ENVIRONMENT IMPROVE THE ACADEMIC PERFORMANCE OF CHILDREN?

Wilkinson, Lora S., McLoud High School, McLoud, Oklahoma 74851; Route 3 Box 231, McLoud, Oklahoma 74851.

This study investigated the effects of touch upon 153 first and second grade student's academic performance using the classroom-test situation task and the reading task. Two types of tests were used: the touched test and the untouched test.

The study investigated whether the number of children affected positively and the number of children affected negatively differed, whether the sex of the child was a determining factor in the child's ractions to touch, whether children reacted differently to brief touch than lengthy touch, whether children reacted differently to a familiar experimenter than to an unfamiliar experimenter, and whether children who initially reacted negatviely to touch could be conditioned to react positively to touch.

The whole classroom population data did not show any significance. However, when the data was analyzed in subgroups according to the effect of touch on the children's academic performance, children who reacted negatively to touch and children who reacted positively to touch were affected significantly, according to the dependent t-test.

The ratio of male to female for children affected negatively and for children affected positively was, respectively, 1:1.2 and 1:1.1.

Children were nearly twice as likely to be affected negatively by touch if I was unfamiliar to the children.

Children's reactions to touch did not tend to be affected by extrinsic factors such as length of touch, source of the touch, or sex of the child. Instead, the elementary children involved in this study reacted to touch under all conditions tested.

#Fourth Award - General Motors ISEF

SECOND YEAR STUDY OF BIRD BEHAVIOR AT WINTER FEEDING STATIONS

Michel, Kimberly K., St. Clair High School, St. Clair, MN 56080
Rt. 1 Box 29, Eagle Lake, MN 56024

The purpose of this experiment was to determine whether the bird species being observed have a patterned preference for food types offered at a winter feeding station in relationship to the behavioral patterns that may be involved in their choices. A winter feeding station was xonstructed with six different types of feeders. The feeders were cleaned and filled with fourteen different food types at regular intervals. Arabic symbols were placed below each feeding compartment to allow the observer to determine from the observation window, which food type the particular species preferred. Observations were made of ten different bird species at various times of the day during a two month time period. Pictures were taken with a 35 mm camera while the different species were feeding. Data collected from observations indicated that each bird species was choosing specific food types. Reasons for their preference was affected by such things as: (a) feeder preferred, (b) dominance over other species, and (c) size of food types offered. The Chi-Square method was then used to validate the quantitative data. This research indicates that the bird species observed do show a patterned preference for certain food types. Subordinate, dominant interrelationships, as well as feeder types offered, have been found to be a determining factor with all observed birds in their feeding preference.

BEHAVIORAL RESPONSE TO OLFACTORY STIMULI-PHASE TWO

Steven S. Collins
Belle Fourche High School, Belle Fourche, SD 57717
813½ Day, Belle Fourche, SD 57717

The olfactory system is probably the most sensitive, most complex and most powerful of all the senses. Olfactory nerves combine with other nerves before entering the brain. Would "crosstalk" between nerves lead to mixed messages and behavioral changes? This question was the basis for the experiments of Phase One. A bowl covered by a screen, then covered by another bowl was used to prove that odors change behavior. But the chamber wasn't completely sealed from outside odors, and any behavioral changes weren't witnessed. This led to speculation that odor wasn't the only factor changing behavior.

In Phase Two, a transparent chamber (9in. x 7in. x 6in.) was used. Filtered air was pumped through a certain odor and into the chamber. 10 mice were used and each mouse was exposed for 5 minutes. After each test in the chamber, the mouse was put on a behavior grid, a box with 30 boxes printed on the bottom. Behavioral traits and the mouse's path were recorded. The results were the same as last year. Chanel #5 and Chloroseptic Throat Spray brought about slow, sedate responses. Cooking wine, vinegar, and beer had "drunk" type responses, like confusing moves and slow reactions. Liquid Wrench and Sunlight Dishwash brought out violent responses. Big Wally cleaner and rubbing alcohol brought out excited behavior. Vanilla showed little change.

The final analysis is that odor does change behavior. Knowing what smells affect what behavior will be important in the perfume, food, and the home improvement industries. If the odor is desirable, people will be more willing to buy the product. Odor is becoming more improtant in our daily lives.

CAN WE ENHANCE THE POSITIVE HEALTH AFFECTS OF NEGATIVE IONS?

Alexander, Anne, Cloudcroft High School, P.O.Box 198, Cloudcroft NM 88317

P.O.Box 691, Cloudcroft NM 88317

My science fair project deals with the effects of varied sound and electrically charged environments on human behavior. I obtained my data by testing a total of nine subjects, seven female and two male. There were three forms of an emotional level measuring test: one test was used as a control and was given under normal room conditions; the second form of the test was given while an air purifier was in operation in the room; the third form of the test was given while the air purifier was on and the subject's favorite tape or record was playing. The tests were then graded and compared to see what the effects of the varied environments had on the various human emotions.

The hypothesis that I had formed at the beginning of my experimentation was that the music and air purifier were going to have a positive affect on the subjects, the reason being that these factors generally create a comfortable and easy atmosphere and people can relax with such conditions. In testing, I have found this to be true. The effects were not as drastic in males as it is in females, however, and usually some emotions were not affected whatsoever in the case of the males.

The emotions that I was testing in my series of tests were: anxiety, stress, depression, regression, fatigue, guilt, extraversion, and arousal.

DOES MUSIC AFFECT TRIAL AND ERROR LEARNING?

Koste, Brad E., Hinckley High School, Hinckley, MN 55037
205 Root Avenue North, Hinckley, MN 55037

The purpose of this project is to find out whether music affects trial and error learning. The individuals who were selected by the researcher were of a relatively high grade point average. These subjects were aware they were going to run through a fingermaze while blindfolded. The subjects were not allowed to view the maze at any time before the experiment. Half of the subjects tested executed the maze with complete silence, the other half conducted the experiment while listening to music. The subjects were timed and times were recorded. The subjects who listened to music while undergoing the experiments had a more difficult time than those who were in silence. Females seemed to learn the maze patterns faster than the males but were more cautious in their procedure. This cautiousness slowed down the times of the females. The males ran through the mazes very fast and did not seem to use any logic and did not really learn the patterns. The music did have a definite effect on all the individuals tested and especially during the more difficult maze.

The Effects of Colors and Word Ordering on Memory.

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3217 Cashion Place, Oklahoma City, Oklahoma 73112.

Everywhere we turn, we are surrounded by colors and words, and yet very few studies have been performed to see if we could beneficially use this fact in our daily lives. This paper describes a set of three studies which attempted to study the effects of colors and word ordering on memory or instant recall. Studies were performed to see if letters and words written in different colors, and also the order of words affected memory. In the letters study, 192 students were shown cards written in four colors: blue, black, red, and yellow. After seeing the cards for 5 seconds, students were asked to record the letters they remembered. The entire population was examined and broken into subpopulations according to age, favorite color, grade point average, handedness, and sex. In the words study, students were shown cards (for a slightly longer time) with words written in the same colors as above. This portion of the study also considered the subjects' eye and hair color as possible variables. In the word order study, students were shown cards with words written in black, which were arranged either consecutively or separated by other words. This study was administered to the same people taking the word color test, and considered the same independent variables. The results indicated that the colors of the letters or words did not significantly affect memory, and that word order did not affect memory. Also, although not statistically significant, results indicate that recall ability was slightly and even substantially affected by the parameters considered.

THE TRANSFER OF PHEROMONES BETWEEN HOMO SAPIENS

Duval, Darla M., Lisbon H.S., Lisbon, ND 58054
RR2, Lisbon, ND 58054

The purpose of this experiment is to examine whether there is an actual exchange of pheromones between Homo sapien teenagers of the same and opposite sexes, as well as between mothers and infants in a relationship called the "family odor".

The experiment was conducted in two parts; one part involved Homo sapien teenagers of the same and opposite sexes, and the second part involved mothers and their infants. For the first part, one individual the receiver, sat behind a screen which covered a box with a plastic tube through it. Teenage individuals entered the room and one by one the individuals breathed through the tube. The receiver was asked what sex the person on the opposite side of the screen was. Using only the sense of smell, mothers compared nightwear of their infant to another infant's garment. The infants were exposed to clothing of their mother and another mother, and any reactions were observed.

Data from this experiment show that females behind the screen responded correctly one hundred percent of the time to the breath, while males responded positively seventy percent of the time. Mothers identified their infant's nightwear in every test. Infants reacted to the mothers' garments in different manners with their age seeming to make a difference. From the above results, it appears that pheromones are actually transmitted between Homo sapiens.

#MNEMONIC DEVICES: A TREATMENT FOR MEMORY LOSS IN ALZHEIMER'S DISEASE AND OTHER MEMORY DISORDERS

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1560 S. Hillock Terrace, Inverness, Fla. 32652

Millions of lives are blighted yearly by Alzheimer's Disease and other memory-related disorders. This study is an attempt to help these patients and their families. Specifically: Can memory skills of persons suffering from these maladies be enhanced through the use of non-invasive mnemonic techniques?

Ten patients, one male and nine female with a mean age of 83, were selected to be tested from a group of patients exhibiting marked memory problems. Subjects diagnoses included: stage 1 A.D., mental confusion and other concomitants of age and illness. The same subjects were evaluated under experimental and control conditions in order to measure individual improvement and to equate groups so variables such as differences in age, sex, duration of illness, medication taken, and educational background could not influence results. An initial Wechsler Memory Scale Test was administered to determine specific memory problems.

An Apple IIc was utilized to present a list of 10 paired-associate words to subjects. The two sets of words presented under control and experimental conditions, although different, were both high on imagery scale (Paivo 1968) and frequency scale (Thorndike Lorge). During the experimental phase words were presented coupled with images while during the control portion words were presented alone. Subjects were taught to a criterion of 2 perfect scores or ten trials whichever came first and were then tested after 15 minutes and 25 minutes. A non-related computer program was utilized as a distractor during both experimental and control intertrial periods. There was a significant improvement at the .001 level in short and long term memory in patients suffering from A.D. and other memory disorders.

#Second Award - United States Army

#LONG TERM RETENTION: HOW WELL A STUDENT RETAINS KNOWLEDGE

Richey, Jennifer Bayne, Brookland-Cayce H.S., Cayce, SC 29033;
1740 Terrace View Drive, West Columbia, SC 29169.

"We're preoccupied with having students memorize a great deal of history, descriptive detail and technology, much of which is out of date and/or relatively unimportant and we are not adequately emphasizing the necessity to understand the major unifying concepts and principles of education..." said the committee of the Curriculum Improvement Act Project. These are the problems the project deals with, the focus upon various levels of math. The hypothesis is students experience lower retention rates when forced to undergo rote memorization rather than when skill understanding is involoved. Three different levels of students, fifth graders, Algebra I students, and Algebra III students, were tested on three math skills: long division, adding "signed numbers," and vector-dot-product problems, respectively. Their retention level was measured with a comparison to those students who took the test with a worked example. The data was reviewed and the following conclusions were drawn: students taking the test without a worked example scored lower than those taking the test with a worked example. The retention level of these students was low possibly due to rote memorization rather than full understanding and application. Concentration needs to be put on understanding skills rather than memorization in our educational system through application.

#First Award - United States Air Force

VISUAL AIDS: ARE THEY REALLY AIDS ??

Ayer, Deborah K., North Shelby High School,
Shelbyville, Mo. 63469, Box 47, Emden, Mo. 63439

The purpose of this project was to determine whether the use of visual aids with oral stories would aid or detract from children's comprehension skills. Because visual aids are used to highlight main points of stories, it was believed that children would comprehend more of a story's context with their use. However, it was discovered that visual aids tend to distract children's attention. Therefore, children's comprehension skills are retarded rather than enhanced by their use.

#EFFECTS OF FENFLURAMINE ON THE COMMUNICATION SYSTEM OF A NON-VERBAL AUTISTIC PERSON

Ibrahim, Kevin, Weber High, Pleasantview, Utah 84404
2569 North 600 East, North Ogden, Utah 84404

Using the computer's speech synthesizer, I prepared to see if it could replace a mute person's speech. I started teaching my subject the basics: matching, letter recognizing and signing. I then taught him to use the language board. Words from the language board were programed into the computer along with a coding system. Data was taken on a daily basis.

As an extension to my past project, I have added a controlled substance known as Fenfluramine. This appetite suppressant has been found to lower the blood serotonin level in some Autistic persons and inprove their social and behavioral skills. I have also improved my computer program to better satisfy the needs of my subject.

I have compiled and compared the results of my testing for both years and found my subject's improvements to be great and promising.

#Honorable Mention - American Speech-Language-Hearing Association

#WEATHER AND WEATHER LOACHES

Roberts, James P., Phoenix H.S., Phoenix, Oregon 97353;
1720 North Phoenix Road, Medford, Oregon 97504.

The purpose of this project is to discover if weather loaches or dojos, Misgurnus anguillicaudatus, possess an unique ability to react to weather conditions. Loaches are eel-like fish with five pairs of barbels who usually live on the bottom of aquariums. No two books or magazine articles agree on their ability to react to the weather. Some authors claim that loaches react to weather conditions when they swim recklessly throughout the aquarium as if stung by a bee. Others dismiss the whole idea completely. I took observations of my weather loaches for four and a half months. I found that dojos only reacted to a drop in barometric pressure. I then set out to discover, by use of test apparatus, if changes in barometric pressure cause weather loaches to swim eratically about an aquarium. My experiments lead me to conclude that only barometric pressure has an effect on the loaches' behavior.

#Second Award - American Meterological Society
Second Award - Sigma Xi, the Scientific Research Society
Second Award - United States Air Force
Third Award - General Motors ISEF

#CORRELATION BETWEEN SELF-CONCEPT AND ACADEMIC ACHIEVEMENT IN A GROUP OF PUERTO RICAN HIGH SCHOOL STUDENTS.

Pérez-Rosselló, Jeannette, Colegio Espiritu Santo,Hato Rey,P.R.00918 501 Juan J. Jiménez, Hato Rey, P.R.

In the Behavioral and Social Sciences, the importance of Self-concept in psychological and social behavior has been emphasized as a basic principle.Self-concept has been defined as the way a person evaluates himself on different aspects about his own person. Previous investigations reveal that the better the self-concept,the better the health, psychological, social and intellectual behavior. Those studies have established a positive relation between self-concept and academic achievement. In Puerto Rico, no specific studies have been carried out studying those two variables. The aim of this research was to find out the relation, if any, between self-concept and achievement of high school students. It was hypothesized that there would exist a positive and significant correlation between self-concept and academic achievement, and that the sex and group placement will be important in the academic average and self-concept of the subjects. A sample of 240 students was randomly selected from advance and average groups. A demographic questionnaire and a self-concept scale were administered. Pearson r Correlation and t Test were performed on the data. The study showed a significant and positive correlation between self-concept and academic averages. No significant differences were found between the self-concept and academic averages of male and female students. The advance group revealed a significantly higher self-concept and academic achievement than the average group. These results might be valuable for planning interventions with students who, having intellectual abilities,are characterized by poor academic achievement.

#Second Award - General Motors ISEF

DEFINING DOMINANT PATTERNS OF PHYSICAL ACTIVITY IN Mus musculus

McCrary, William S., Fort Zumwalt Sr. High, O'fallon,MO 205 Donald, O'Fallon, MO 63366

Biological rhythms and behavioral patterns based upon environmental stimuli play an important role in controlling many life processes and behaviors. The studies of these rhythms and how they effect bodily functions constitute an important field of study in the science of Zoology. In 1963, Mr. Stanley Beck of the University of Wisconsin conducted a series of tests to determine the effect of photo-periodism on the running activity of the White-footed mouse, Supported by the results of his experiments ,he concluded that " White-footed mice and other animals possess a rhythmic behavior that is both endogenus and circadian in nature." The objective of this experiment is to determine if the daily running distance for Mus musculus would develop a pattern. The necessary data was obtained by recording the average daily running distance. Temperature, type of food, and food amounts were kept constant. Upon conclusion of the experiment there was sufficient evidence to suggest that the variating pattern s of physical activity exhibited by specimens of Mus musculus over a twenty day period are related and fluctua te according to a four day pattern that is evident in all data. Furthur research indicates that this pattern may be due to ovulation cycles of the mice.

#NEURAL MECHANISMS OF VISION AND THE EVOLUTION OF THE ALPHABET

Dworkin, Jonathan E., Hershey H.S., Hershey, PA 17033
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It is hypothesized that the neural mechanisms of form perception in the human visual system have influenced the evolution of the Roman alphabet. Consequently, in the process of optimizing visual processing efficiency, the shapes of letters would take advantage of the range of forms effectively discriminated by the visual system. The correlation between the performance of a computer simulation of a model of the neural mechanisms of form perception and human performances on the task of letter discrimination should provide a particularly accurate measure of the validity of that model.

In the first part of the project, human subjects were tested in a psychophysical experiment based on a letter discrimnation paradigm with the Roman alphabet and two of its antecedent alphabets. The percent discrimination errors per experimental trial decreased .34%/century, ($p<.05$). In the second part, an original computer simulation of the feature detector model of the form perceptual mechanisms (Hubel and Wiesel 1962) was developed and its performance on the task of letter discrimination compared to human performances. This correlation was calculated as a function of a parameter representing the membrane thresholds of the neurons in the hypothetical neural network. Unique non-linearities of the model's performance may have implications for the effect of the magnitudes of neuronal membrane thresholds on perceptual performance. An optimization of this parameter resulted in a maximum correlation (.2975) similar to those reported for other models of the neural mechanisms of form perception.

#First Award - American Optometric Association and the Auxiliary to the American Optometric Association
First Award - American Psychological Association
First Award - United States Navy/Office of Naval Research
First Award - General Motors ISEF

CHEMISTRY AND THE PERSONAL COMPUTER: DOES THE COMPUTER ENHANCE LEARNING?

Wayne, Dawn E.,Victoria H.S.,Victoria, Tx.77901;
207 Salisbury, Victoria, Tx. 77904

This study is concerned with the effects of learning and reinforcing Chemistry concepts with the personal computer. The hypothesis states that there will be a significant difference in the rank order of the achievement scores of the computer-assisted group. The study required eight sophomore students. The sophomores were chosen because they had been selected by the guidance office as qualified to take Chemistry as sophomores. This indicated that these students had met specific criteria for this selection in their ninth grade science and math classes. The sample size was limited by the requirement of comparable ability and prerequisite courses. Four students were used as the control group and received no computer assistance. The remaining four students had concepts introduced by the computer as well as by traditional methods. These four students worked with chemistry programs twenty minutes three times a week. The computer programs used were authored by Compress, The Dreyfus Institue, and the researcher. The eight students received identical classroom instruction by the same teacher. The data was compiled and evaluated in six week blocks using The Wilcoxon's Sum of Ranks Test. At the end of twenty-one weeks all data was compiled and evaluated using an Analysis of Variance. These evaluations indicated a significant difference in the scores of the two groups.

#MEMORY RETENTION IN SOCIAL INSECTS, Jackson, Paul C., Starkville H.S., Starkville, MS 39759 Box 5273, MS ST., MS 39762

The first problem to be solved in studying the memory of any animal concerns the role of receptors in activity. My research not only involves the mechanics of orientation but also investigates the importance of kinaesthetic and contact receptors.

My investigations are based on the belief that insects profit by experience in their orientation. The maze situation enables close examination of this theory, under rigid control. A considerable portion of this study is devoted to the importance of patterns for the course and repetition and rapidity of learning.

I began a series of experiments on the receptors of insects and how these aided in the acceptance and retention of stimuli. By testing each sensory system I could learn its origin and capacity. I also tested one sense against another, or involved two or more of the senses in experiments concerning confirmed recognition. After repetitive conditioning of insects to a specific stimuli, conditions were changed and insect response was noted accordingly.

The results of investigations into the capacity of memory systems of the social insects placed them near the peak of insect learning.

#Honorable Mention - American Psychological Association

QUANTIFICATION OF NEONATAL STRESS LEVELS INDUCED BY THE BRAZELTON
Bankston, Laurie A., Columbia H.S. Lake City, FL 32055
Route 1, Box 657, Fort White, FL 32038

This project attempted to develop a method for quantifying neonatal stress induced by behavioral examinations via cry analysis. Two analyses were conducted: (1) crying time percentage and (2) peak intensity of cry sample. Mean stress percentage was 27.87% with a standard deviation of 18.09%. Mean peak intensity was 0.43 volt with a standard deviation 0.19 volt. These results do not define normative ranges for either stress percentage or peak intensity; however, they do provide a basis for further research. Quantification of neonatal stress experienced during behavioral examinations would facilitate the identification of least stressful methods of behavioral assessment.

AN ECOLOGICAL STUDY OF ACHETA ASSIMILIS AND PERIPLANETA AMERICANA WITH SPECIAL ATTENTION TO A COMPARATIVE ANALYSIS OF THEIR ESCAPE SYSTEM
Pagán, Luis M., Colegio Ponceño, Ponce, PR 00731;
Santa María 25 E-6, Guayanilla, PR 00656.

Along with studying the habitats of the Acheta assimilis and Periplaneta americana, I performed a comparative analysis of the escape system of both.

The movements of any organism through the air generates tiny air currents. I found that (A. assimilis) and (P. americana) flee from possible dangers by detecting these currents with an arrangement of very sensitive hairs in their cerci, an amazingly precise wind detector.

With subtle air puffs I tested their ability to locate the source of the currents, and to turn away to evade what they think is a threat to their survival.

These orthopterans are very widespreade due to the fact that they prefer humid, warm places, with slight ilumination. They find such places beneath rocks or grass, in many man made structures (basements, cabinets, behind appliances or trash) and in their own dug burrows, although cockroaches like P. americana prefer antihygienic places such as sewage ducts and others.

DEVELOPMENTAL COMPARISON BETWEEN PERCEPTUAL ABILITIES AND LONG-TERM MEMORIZATION ABILITIES IN LEFT AND RIGHT-HANDED CHILDREN

Ehlis, Lisa M., St. Mary's High School, New England, N.D. 58647; Rt. 2, Box 84, New England, N.D. 58647.

What is the direct relationship between perception and long-term memorization? Does handedness, age, or cerebral dominance make a difference in the carrying out of these abilities?

Eighty subjects were tested for this experiment. Each age group consisted of forty subjects. Kindergarten and First Grade make up the younger age group. Third and Fourth Grade students make up the older age group. From each of the four age levels, twenty subjects were used, ten left-handed and ten right-handed.

The subjects hemisphericity was determined. An equal number of left-brained and right-brained tests pertaining to perception and long-term memorization were presented to every subject individually. The subjects were scored by the percentage of correct answers. These percentages were averaged to determine the results for the various com comparisons made.

The subjects scored an average of 35% better on the memorization tasks than the perception tasks. The right-handed subjects had slightly higher scores than the left-handers for the perceptual and memorization abilities. The third and fourth grade age group proved to have scores about 15% higher than the younger age group consisting of kindergarten and first grade students. Subjects with left-cerebral dominance did about 3% better than the subjects with right-cerebral dominance and about 6% better than the subjects with mixed dominance.

The perception and memorization tasks were graphed separately, normal curves were drawn and scatter plot graphs were completed to determine further comparisons.

INSIGHT DISPLAYED BY RATS

Angle, Donald A., Clear Spring High School, Route 2, Box 118, Clear Spring, Maryland 21722; Route 3, Box 124A, Clear Spring, Maryland 21722

In this experiment the objective was to show that rats can and will, if given the chance, transfer previously observed information and use insight rather than trial and error to solve a maze.

The rats used were exposed to a maze and after it was observed that they had a consistently low number of errors in that maze, it was changed. Three mazes were used and each was accompanied by a string which denoted the correct path of the maze. The string gave the rats the chance to use insight. If the rats used the string to solve the mazes, their times and errors running the mazes would diminish more quickly than if they solved the mazes by trial and error.

While in the maze, notes were taken on the rat's behavior and each trial was timed. From the notes on behavior an "error graph" was derived showing that the errors diminshed in a more rapid manner with each maze that was introduced. A "time graph" was also made and, to a certain extent, it correlated with the "error graph". In the literature research it was found that the "error graph" was more valid than the "time graph".

The notes taken on behavior show that the rats did acknowledge the string when making a decision as to what path to take.

In conclusion, it was found that the rats did use insight after the second maze was introduced.

#USING VISUAL ACCESSING CUES TO DETERMINE EFFECTIVE MEMORY STIMULI

Burns, Victoria B., Terrebonne H. S., Houma, LA 70360
P. O. Box 568, Houma, LA 70361

Memory is generally perceived by scientists as a function of several parts of the brain. Because two main types of stimuli, visual and auditory, are associated with memory, the purpose of this project is to try to determine the extent to which memory is influenced by stimulus type. Work proceeded in a manner as to apply the theories of Richard Bandler and John Grinder regarding visual accessing cues as a possible indicator of neurological function.

Hypothesis: A person who primarily employs a visual representational system will achieve greater learning when presented with a visual stimulus. A person who primarily employs an auditory representational system will achieve greater learning when presented with an auditory stimulus. Because visual accessing cues are indicators of representational system, they are also indicators of effective memory stimuli.

Method: 150 subjects over age 12 were screened for representational system by observation of response to 6 control and 4 experimental questions. Each subject was then asked to read or listen to a short history passage and answer, either written or orally, questions concerning the material.

Results: In an average comparison of age groups, subjects who employed a visual representational system scored highest when writing answers to material they had read. Auditory subjects scored highest when responding orally to material they had heard. Scores were lowest when system/stimulus/response were mixed. Differences decreased as subject age increased.

Conclusion: The hypothesis is true when comparing average scores of each group of subjects but may not be valid for each individual. This experiment is significant in the study of the relationship between the psychological and physiological nature of memory.

#Honorable Mention - American Optometric Association and the Auxiliary to the American Optometric Association

A SMART PILL IN OUR FUTURE?

Davis, Tanya L., Willow Glen H.S., San Jose, CA 95125
2753 Cherry Ave., San Jose, CA 95125

If a trained planarian is laterally bisected, will both of the regenerated worms be trained? My hypothesis was that the anterior half would regenerate as a trained worm and the posterior half as an untrained worm. However, the posterior half would retrain more quickly than a worm regenerated from an untrained worm.

I conditioned the worms to react as to an electrical shock, given a light stimulus. I shone the light briefly and then introduced the electrical current. I counted the number of trials it took before the light evoked the response normally associated with the electrical shock.

Scientists have found that planarians can be trained, and that an untrained planarian will become trained when fed a trained planarian. Scientists have also found data to support the theory that it is ribonucleic acid (RNA) which transmits the learning trait. To the best of my knowledge, no study has been done on whether the RNA is isolated in the head ganglia, or whether it is found throughout the entire body. By bisecting them, and having them regenerate, I found that the "learning carrier" RNA is found throughout the entire body, but concentrated in the head ganglia.

One question I came across is whether the number of times per day the worms were trained affected the worms' rate of training.

I thank my school's science department for obtaining the planarians and a professor at the local state university for helping me take my close-up pictures.

Generation Gap as Measured by Terminal and Instrumental Values: Actual or Perceived?

Oraker, Jennifer, Irving Junior High School, Colorado Springs, CO 80909

3060 Caravan Ct., Colorado Springs, CO 80917

To determine the degree of agreement or disagreement on values between parents and middle adolescence, a group of junior high school male and female students and their parents in an urban Colorado community filled out the scales of instrumental and terminal values contructed by Rokeach. In addition to a comparison of actual values, perceived values were measured. Also of interest was whether or not a communication workshop would increase the understanding of each other's values. Finally, values differences between 7th and 9th grade male and female students were evaluated. Spearman rank-order correlations showed both agreement and disagreement in actual and perceived values with greater disagreement found in actual values. More differences were found in terminal values than in instrumental values. The communication workshop did increase the accuracy of understanding each other's values and while females in the 7th and 9th grades had little or no divergence of values, a greater values difference was reflected in males with instrumental values being significantly different between 7th and 9th graders.

#A CORRELATION BETWEEN CHRONOLOGICAL AGE AND THE EFFECTS OF GROUP PEER PRESSURE ON DECISION MAKING.

Sullivan, Patricia J., Sentinel H.S., Missoula, MT 59801;
403 Westview Dr., Missoula, MT 59803

To what extent is decision making influenced by peer pressure? And does the effect of peer pressure differ with increasing chronological age? In an attempt to answer these questions, experimental subjects were asked to match lengths of lines while at the same time a peer group provided incorrect answers in unison. The frequency with which subjects succumbed to the majority decision was compared to their tendency to trust their own perceptions. Data was obtained from four different chronological age groups. The two younger groups conformed to the decisions of their peers to a surprising degree. As a person ages, however, the more confident he or she becomes in making correct judgements in opposition to a majority opinion.

#London International Youth Science Fortnight - United States Navy/Office of Naval Research
Third Award - General Motors ISEF

#MOODS AND MUSIC

Gallman, Melanie, Friona High School, Friona, Texas 79035;
Route 1, Friona, Texas 79035.

Do-Ra-Me-Fa-So-La-Te-Do! Does music affect a human mood? This project was designed to determine how different types of instrumental music affects the mood of an individual. The materials used were a tape player with earphones (the earphones isolated the individual from all external sounds), five types of music (country, classical, hard rock, a march, and easy listening), Hevner's Adjective Checklist, and thirty experiment subjects. Each subject was provided with an adjective checklist. While a selection of music was played, he or she circled any number of adjectives in any group, describing the emotional feelings aroused while listening to the particular excerpt of music played. The subjects followed this procedure for each of the five types of music. Results prove that moods produced by musical compositions are "strikingly similar" within the majority of subjects, regardless of age, training, or experience. Since the degree of response agreement was high, it indicated that music does indeed have an affect on the human mood.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society

SURVIVAL OF THE STEADIEST: AN ANALYSIS OF THE EFFECT OF TENSION ON STUDENT ACHIEVEMENT IN REGARD TO STUDENT TESTING SITUATIONS

Lamos, Valerie H., Canterbury High School, Fort Wayne, Indiana 46804
4624 Weatherside Run, Fort Wayne, Indiana 46804

The purpose of this project was to discover the effects which stress has on students and their testing ability. Interest in this project began as a result of last year's Psychology project; I perceived large amounts of tension in my classmates during semester finals and decided that a study of that tension would be interesting and helpful. The hypothesis for this research was: Tension has a definite effect on a student's testing ability and mental status. The method for this project included the following steps: (1) collecting background information and researching my ideas; (2) designing three testing procedures; (3) measuring student reactions through the following test procedures (inclusive of all high school students): A) an oral survey, B) a written tension test, C) a tension questionnaire; (4) recording my observations; (5) charting the results from tests and surveys; (6) formulating information into graphic ratios and percentages in order to analyze my data. In addressing my hypothesis, the data does not appear to support the initial premise. However, as a result of the investigative nature of this project, certain conclusions and indicated areas for further research emerged, inclusive of nervousness appearing to have a greater effect on students scoring either very high or very low in a range.

THE EFFECTS OF STRESS ON ALCOHOL CONSUMPTION IN MICE

McNeil, Robert S., Permian H.S., Odessa, TX 79760
2825 Tanglewood Lane, Odessa, TX 79762

The purpose of this project is to determine whether or not a stressful environment will induce alcoholic tendencies in mice. The results of this experiment will confirm if there is a link between stress and alcoholism.

The procedure used in this experiment includes the separation of two groups of four female mice in separate cages. Each cage will be equipped with a bottle of water and a bottle of 12% alcohol solution. The control group will be placed in a stress-free environment while the experimental group will be subjected to various forms of stress. The amount of alcohol and water drank by both groups will be measured each day and a ratio of alcohol drank by both groups will be found. Additional trials of this experiment will be conducted to increase accuracy and insure consistent results.

The findings of this experiment clearly show that the mice under stress consumed more alcohol than the control group. The experimental group drank 102 cc to alcohol while the control group drank 35 cc. This is almost a 3 to 1 ratio. The stressed mice also exhibited extremely nervous and abnormal psychological behavior. The control group displayed normal, healthy behavior.

The conclusion reached from these findings is that a stressful environment significantly increases the rate of alcohol consumption of organisms living in such an environment. Alcohol is used as an outlet for the anxiety and tension produced by a stressful environment.

Further research in this area may help determine new ways of treating alcoholism and finding healthy outlets for stress.

#A THREE YEAR STUDY: THE EFFECT OF COLOR ON MICE

Swain, April L.,Palm Beach Gardens High School,PBG,Fl33410
9134 Demery Dr., Palm Beach Gardens, Fl 33410

This experiment was initiated to examine whether color has an affect on mice. In the third year of study,sixteen female and sixteen male mice were used, for a total of thirty two mice. The mice were separated into different color cages with two of the same sex mice in each cage.The colors used were red, blue, green, yellow, pink, multi-color and four control cages. The duration of the experiment was two months.

The food and water intake, respiration and heartrate were recorded daily. Weight, length and miles accomplished on the speedometer were recorded weekly. The mice were also ran through a maze each week. Blood samples were taken and differential blood cell counts were performed on each mouse twice during the experiment.

The conclusion was the blue caused a calming effect,red and multi caused an active effect, pink caused a calming effect at first but then an active effect, yellow caused an active effect and green showed no abnormal effects.The red and multi color mice both had adverse changes in their blood patterns by the end of the experiment.

In today's society we are constantly surrounded by color and we can become greatly influenced by it. Color plays a big role in our lives today and may become more useful in the future. This indicates a need for additional investigation with color and it's effects, as well as it's possible uses.

#Fourth Award - General Motors ISEF

OPTICAL ILLUSIONS-DO YOU SEE WHAT I SEE?

Melton, Mary K., Manatee H.S., Bradenton, FL 33505
1000 32nd St., Bradenton, FL 33505

The purpose of this science project was to determine if (1) Do age and sex affect a person's ability to discern optical illusions? (2) Does the color of the illusion affect a person's ability to discern it? (3) Does a person's hemispherical dominance (left-right) affect the way he discerns an optical illusion?

Three phases in the form of three tests were composed for this project. After researching optical illusions at various college campuses for three months I began Phase I. For Phase I chose ten of the hundreds of illusory patterns to use in my study. After making up a test and an answer key to accompany the illusions I transferred the illusions onto posterboard. Next I tested approxiamately 300 school age children in three categories (9-12, 13-15, 16-19). After performing a statistical analysis on the results I found that sex was not a factor but age was. For Phase II I selected 5 of the ten illusory patterns used in Phase I and transferred them to posterboard in three different colors (red, blue, and yellow). After repeating the testing process I found that color also affected the way a person discerned an optical illusion. My statistical analysis showed that the participant scored higher on the designated test when the illusion was shown in yellow. PhaseIII consisted of a short ten question questionaire that determined whether a person was left or right dominant and depending on which they were how well they scored. The results, after a statistical analysis, proved to be very interesting, showing that dominance, as well as age and color affected the way a person discerned an optical illusion.

#IT'S NOT JUST WHAT YOU SAY. . .BODY LANGUAGE

Morrison, Julia L., Marion H. S., Marion, VA 24354
321 College St., Marion, VA 24354

The purpose of this project was to investigate the multiple aspects of how man interprets, transmits, and understands nonverbal communications. In order to attain information about nonverbal communications many observations, surveys, and tests were completed. Observations were made of how man relates nonverbally in social situations such as courtrooms, shopping malls, waiting rooms, classrooms, and so forth. Surveys were made to gather how man interprets facial expressions, gestures, body positioning, and reactions to pupil response. People were tested on their ability to interpret social body language in our culture.

The tests and surveys revealed that nonverbal messages are interpreted and understood by a large majority of people. Most of us do not want to misunderstand or insult another person, or appear to be stupid or crude in front of others. Without knowledge of nonverbal (body) language this can happen. Nonverbal communication is valuable in interrelationships in society and may be the key to a person's success and happiness in life. We have the ability to make people happy or make them miserable with the wave of a hand or the flash of an eye.

Wherever one goes, people are communicating nonverbally. And it is up to all of us to try to understand our fellow human beings a little bit better by learning what they are "saying" to us when they are saying nothing at all.

#Fourth Award - General Motors ISEF

#ASPECTS OF COMMUNICATION AMONG RINGNECK PHEASANTS-
AN INVESTIGATION OF DISTINCT VOCALIZATION PATTERNS

Curtis, David K., Detroit Country Day H.S., Birmingham, MI 48013
685 Hillcrest Drive, Bloomfield Hills, MI 48013
SPONSOR: Randall E. Raymond

According to Webster, communication is defined as "the exchanging of information by signals, by messages, by talk, or by gestures." Communication among humans is one of the most essential constituents to our society. One of the most important aspects of communication is that it enables our species to survive. Do animals other than humans communicate? Do they warn each other of danger? Do males and females of the same species react differently to similar stimuli? The purpose of this study is to examine possible answers to these questions by trying to discover consistent, vocal-physical behavioral patterns among Ringneck Pheasants after they are subjected to a pre-recorded pheasant vocalization. The calls were recorded and isolated through the use of a Bionic Ear listening device which would reproduce a high-quality, static-free pheasant vocalization. The patterns of communication were examined in two different conditions. The first, where a pheasant was placed in an isolated environment and the second, when the pheasants were altogether in one pen. The most common response to the tape was recorded for both male and female pheasants. The data indicated that both male and female Ringneck Pheasants consistently responded to the pheasant vocalization. Male pheasants responded more aggressively to male vocal patterns, while females appear to, in some cases, use vocalization patterns that have little or no effect on the males.

#First Award - American Speech-Language-Hearing Association
Honorable Mention - American Psychological Association

THE EFFECTS OF EXTRACTS OF PANAEOLUS SPHINCTRINUS IN THE BEHAVIOR OF THE HAMSTER MESOCRICETUS AURATUS

Perez, Eileen, Lola Rodríguez de Tió High School, San Germán, P.R. 00753; Urb. Porta Coeli, B-8, San Germán, P.R. 00753.

One of the sacred hallucinogenic mushrooms employed in divination and other magic ceremonies by the chinantec and mazatec indians of Mexico is a member of the small genus Panaeolus. It is known as pasture mushrooms or intoxicating mushroom. Panaeolus sphinctrinus is a delicate yellowish brown mushroom up to four inches in height whose status among the hallucinogenic mushrooms is in doubt.

This study represents an attempt to study the effect of extracts of the fungus Panaeolus sphinctrinus on the behavior of the hamster, Mesocricetus auratus.

Three experimental groups were set up all consisting of two hamsters as controls and 2 of each sex as the experimental ones. Group was given extract at a 10% concentration while B had 5% and C had a 1% concentration. The extract was administered after a period of acclimation for 30 consecutive days. Food and water consumed by all organisms was carefully recorded and daily weight were also recorded.

Effect was measured by direct observation of behavior. A color preference test was used to determine effect of extract on behavior. This was supplemented by a balance test and a running wheel test. Behavior of experimental animals was altered by the extract of the fungus. Experimental organisms drank more water than the controls as well.

BIOCHEMISTRY

#EXTRACTION OF OIL FROM EUPHORBIAECEAE AND ITS USES

Gregory, Shannon L., Burkburnett H.S., Burkburnett, TX 76354, 1020 Pawhuska, Burkburnett, TX 76354

Over the past ten years, extensive research has been underway to use plants from the family Euphorbiaeceae as a future energy source. This family possesses a latex which contains hydrocarbons similar to that of crude oil. I chose the Euphorbia marginata, a native Texas weed. My findings from this plant were compared to its sister plant, Euphorbia lathyris.

The E. marginata thrives in pasture lands in the plains region of the West. It requires little moisture or attention and can easily grow in grazing or oil fields. Its sister plant produces 10 barrels an acre each year at the cost of approximately $100 a barrel. However, genetic engineering of the lathyris plant will hopefully increase production to that of 20 barrels an acre. This would reduce the price of a barrel to approximately thirty dollars.

For the plant to be used as an energy source, it is important to know its heat of combustion. Through experimentation of my oil using a sodium peroxide calorimeter, I have found the heat content of my oil to be 4727.53 kcal/mole or 11.2027 kcal/gram. By comparing this to other hydrocarbons, I found its chain to be a length of approximately thirty lengths, which is an ideal length. The British thermal units of the oil is 18,759 Btu/lb compared to that of crude oil 19,000 Btu/lb. This indicates that this plant produces an oil which can be easily converted into energy.

#Second Award - United States Air Force

Second Award - United States Army

ATP DETERMINATION OF HEARTWORM-INFECTED CANINES

Robbins, Catherine Ann, Englewood H.S., Jacksonville, FL 32207
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Difficult to diagnose until at least six months after the initial infection, the canine parasite Dirofilaria immitis (heartworms) is rapidly spreading throughout the nation. The purpose of this project was to standardize the adenosine triphosphate (ATP) bioassay developed during the previous year to detect the presence of heartworms in blood samples of infected Canine familaris subjects. The hypothesis stated that the levels of ATP would be higher in heartworm-infected subjects due to an immune response and that the infected canines would show higher ATP readings prior to treatment than during or after treatment for D. immitis. NASA's "Firefly Test" utilizing luciferin and luciferase in ATP determination to assess the ATP levels was conducted at Jacksonville University. A Fluoro-Colorimeter was the instrument used to obtain the readings. For this experiment, twenty microliters of luciferin-luciferase were added to one milliliter of blood serum for each sample. Using the "Firefly Test" over half of the samples were correctly diagnosed as to the actual condition, positive or negative. Additionally, chem screens of the subject canines were analyzed for possible corollaries. In each infected case, one or more of the chem screen functions were usually elevated. This use of the "Firefly Test" as a diagnostic tool for the detection of heartworms is a possibility, but the testing procedure needs to be refined. Practical applications of this project: a possible test for filarial worms in humans and as another test for heartworm detection in dogs.

#THE EFFECTS OF SOME ENVIRONMENTAL CHEMICALS ON PLATELET FUNCTION

Gear, Andrew J.L., Western Albemarle H.S., Crozet, VA 22932;
Grassmere Farm, Ivy, VA 22945

Blood platelets are essential for normal clotting. If they work too well, heart attacks and strokes can happen or bleeding may occur when platelet function is inhibited. Many chemicals such as aspirin are known to block platelet function, and knowledge of how they react is important for predicting their effects on blood clotting. This study was designed to test the effects of some common environmental chemicals on platelet aggregation: alcohol, nicotine, chloroform, carbon tetrachloride, and the insecticides 'Sevin' and 'Diazinon'.

Human venous blood was used to prepare platelet-rich plasma which was then tested with the various chemicals. Adenosine diphosphate (ADP) served as the natural inducer of aggregation. The rate of aggregation was derived from measuring the numbers of single platelets disappearing after ADP stimulation. The results showed that nicotine stimulated aggregation, while alcohol, 'Diazinon', chloroform and carbon tetrachloride were all inhibitors. The concentration of alcohol used was similar to that seen in plasma after drinking about 3 beers. The insecticide 'Sevin' had very little effect, while 'Diazinon' was a powerful inhibitor. Control tests with the solvent system of 'Diazinon' suggest that the inhibition seen is truly a result of the potent anti acetylcholinesterase activity of this organophosphorus insecticide.

These studies reveal that some common chemicals may alter the efficiency of blood clotting and be quite toxic. Organophosphorus compounds, in particular, seem to be most dangerous.

#First Award - United States Navy/Office of Naval Research
Alternate to Scholarship - United States Navy/Office of Naval Research

#BIOCHEMICAL CHANGES IN CANAVALIA MARITIMA (BEACH BEAN) SEEDS DUE TO GERMINATION.

Graham, Dorothy J., Hostos High School, Mayagüez, P.R. 00708;
Flamboyan 186-P, Bellas Lomas, Mayagüez, P. R. 00708.

Canavalia maritima beans were collected, the seeds were removed from the pods, dried, and ground to pass an 80-mesh sieve. Tests for protein, total carbohydrates, ascorbic acid, moisture and total polyphenols were done on meal prepared from ungerminated and germinated seeds.

The values for protein (25.73%) and total carbohydrates (51.46%) decreased after germination, as compared to ungerminated seeds (28.87%) and (53.70%). The polyphenol content decreased 9.1% in the flesh of the seed after germination, 75.6% in the skin of the seeds after germination, and decreased 66.9% in the entire seed after germination. The values for ascorbic acid (100 mg/100g of material) and moisture uptake (34.22%) increased after germination, as compared to ungerminated seeds (11 mg/100 g of material) and (7.33%) for ascorbic acid and moisture, respectively.

The seeds germinated very slowly because of the tough outer layer. Therefore, the outer layer was cut (scarified) to speed up the water absorption and germination.

In vitro digestion of meal from germinated seeds by pepsin and amyloglucosidase was more extensive than in meal from ungerminated seeds. This indicated that decrease in polyphenol content after germination resulted in an increased nutritional value of the meal prepared from the seeds.

Paper chromatography showed the presence of glucose and the absence of fructose, maltose, sucrose and raffinose in both germinated and ungerminated seeds.

#Fourth Award - General Motors ISEF

#TARTRAZINE (YELLOW NO.5); AS A POSSIBLE AGENT OF CELLULAR DEGENERATION IN THE LIVER AND KIDNEY IN THE MUS BALB-C

Delpín Herminio - John F. Kennedy High School
Santa Isabel, P.R. 00757
Urb. Buenos Aires B-27 - Santa Isabel, P.R. 00757

This investigation intended to prove if the tartrazine, an artificial coloring, is a possible cause of cellular degeneration of the liver and kidney in the Mus Balb-C.

The experiment was divide in three phases: Where tartrazine solution was administred orally three times daily at a concentration of 0.05%, 0.5% and 1%. The mice were weighed and mesured every five days, per 37 days and also physical observations were taken every day during the scientific investigation.

According to the data found in my investigation, tartrazine produce granuloma, hemorrhage and hepatic degeneration in all three phases of experimentation (.05%, .5%, 1%). Mono nuclear infiltration, vacuole degeneration and some regeneration are present in phase two and three. When the concentration of tartrazine is increase more patological disase are founded.

According to my data I would generalize that tartrazine influences greatly in the loos of weight of Mus Balb-C and cause damage to liver and kidney in the three stagger of the experimentation.

#Fourth Award - General Motors ISEF

AN IN VITRO STUDY OF EXTRACTS OF THE PLANT LEUCAENA GLAUCA (L) BENTH AS A POSSIBLE BLOOD CLOTTING AGENT.

Aponte, Ana L., CROEM H.S. Mayaguez, P. R. 00709;
Pedro María Descartes Residental,
Building #1 Apartment 5, Santa Isabel, P. R. 00757.

This research is an in vitro study to prove that the pure extract of "LEUCAENA GLAUCA" (known as Zarcilla) is a possible blood clotting agent. The purpose of this study was to find a simple form to stop hemorrhage and help people that suffer from hemophilia.

For this research I carried out some agglutination tests of diverse types of sanguinean groups. These test studied the time of normal clotting adding the pure extract of "LEUCAENA GLAUCA" with distilled water and saliva. Based on these tests I established that the pure extract of "LEUCAENA GLAUCA" acted as a blood clotting agent and was more effective with saliva than with distilled water.

THE ACTION SPECTRUM OF ELODEA PHOTOSYNTHESIS

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Fourteen centimeter long sprigs of Elodea grown in nutrient solution were placed in separate bottles containing water and set in darkness to deplete the oxygen. Each sample was subsequently exposed to specific wavelengths of light of equal intensity or exposed to white light at higher intensity for twenty hours. At the conclusion of the test periods, the oxygen output was measured by the Winkler titration method.

Elodea samples which were different in appearance had different oxygen production rates. These samples were tentatively identified as E. densa and E. canadensis.

It was found that Elodea photosynthesis was most rapid under blue light at 450 nm. This is significant because photosynthesis of most higher plants is more rapid under red light of 650 nm.

Oxygen output of E. densa was measured after culturing under light from 10°C to 40°C at 10°C intervals. The optimum temperature for photosynthesis was 20°C.

ISOZYMES AND OTHER PROTEINS AS GENETIC MARKERS FOR ICTALURUS SPECIES

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Liver esterase and acid phosphatase isozymes of Ictalurus punctatus (channel catfish), I. catus (white catfish), and their hybrid I. punctatus x catus (channel x white) were separated by isoelectric focusing and non-denaturing polyacrylamide gel electrophoresis. Liver proteins were separated by one- and two-dimensional electrophoresis. Isozyme Es-2 was common to both species and their hybrid, whereas Es-1 was unique to channel. Two genes were postulated to be involved in the expression of Es-1 and Es-2. A third gene may be responsible for the repression of Es-1 in white and the hybrid catfish. Isozyme Ap-2 was common to both channel and white as well as their hybrid, while white had three additional isozymes (Ap-1, Ap-3, Ap-4). Similarly, a repressor or repressors may be responsible for the inhibition of Ap-1, Ap-3, and Ap-4 in channel and the hybrid. Over 300 proteins were detected in each species. Unique proteins for channel and white were identified, and a combination of these proteins was found in their hybrid. These major diagnostic protein variations can be used as interspecific genetic markers.

ACTIVATION OF METHIONINE SYNTHETASE: EXPLORATION OF THE BASIS OF A GENETIC DISEASE.

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Methionine synthetase is an enzyme in the body which places a methyl group from methyltetrahydrofolate on homocysteine, making the amino acid methionine, a physiological carrier for methyl groups. The enzyme requires reduction in order to be active, but the physiological reducing system is not known. Recently, a patient has been studied who appears to lack this physiological reducing system and whose enzyme is therefore inactive. The purpose of these studies was to identify the physiological reducing system for this enzyme. The first set of experiments done were screening experiments. I tested various thiols and pyridine nucleotides for their ability to activate methionine synthetase. While all thiols tested were found to activate methionine synthetase in the presence of added vitamin B_{12}, only cysteamine was active in its absence. I felt that vitamin B_{12} was reducing the oxygen tension in the enzyme mixture; this would make the enzyme more effective because methionine synthetase is very sensitive to oxygen. I found several enzymes which could play the role of B_{12} in the physiological cell, that is they could use cysteamine to remove oxygen from the cytoplasm. An experiment was done which showed that methionine synthetase had greater activity in the absence of oxygen. Finally, I showed a correlation between the reduction of oxygen tension and the activation of methionine synthetase. This leads me to believe that the patient lacked one of those enzymes for the reduction of oxygen tension.

INVESTIGATIONS OF THE IN VITRO ACTIVITY OF A VIRAL GENE LEADING TO THE POSSIBLE DISCOVERY OF A NOVEL CONTROL REGION FOR THIS GENE.

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The Adenovirus 2 (Ad2) VAI RNA gene was selected to clone into a bacterial plasmid to study as a model system for the in vitro transcription of a class III gene. Four fragments of Ad2 DNA, one containing the VAI gene, were created by digesting Ad2 DNA with the restriction enzyme SalI. SalI cuts the Ad2 genome approximately 0.8 kilobases (kb) upstream and 5.9 kb downstream of the VAI gene. By using recombinant DNA techniques, the fragment containing the VAI gene was cloned into the plasmid pBR322. An in vitro transcription system containing an extract prepared from HeLa cells was used to test the transcriptional activity of the VAI gene. Surprisingly, the cloned gene's in vitro activity was found to be much lower than the activity of the gene on the intact Ad2 genome. After testing and rejecting several possible explanations for this difference, it was hypothesized that the initial SalI cut removed regions upstream or downstream of the VAI gene that were important for its transcription. When Ad2 DNA itself was cut with SalI, it was found that the VAI gene on SalI cut Ad2 DNA transcribed at much lower levels than the gene on the uncut genome. Next, a fragment of Ad2 DNA that was 9.4 kb longer upstream and 4.4 kb longer downstream than the SalI fragment containing the VAI gene was created with the restriction enzyme EcoRI. The VAI gene on this larger fragment transcribed at essentially equal levels with the gene on the uncut Ad2 genome. This indicated that the SalI cut may have removed a region of DNA either upstream or downstream of the VAI gene that increases its transcriptional activity, and that the EcoRI cut did not remove this region. This suggests the possibility for the existence of an enhancer-like control region for the VAI gene located somewhere on either the 9.4 kb or 4.4 kb length of DNA on either side of the SalI fragment. This is the first time such a control region has been described not only for the VAI gene, but also for any class III gene.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Second Award - General Motors ISEF
Fourth Award - American Chemical Society

IMPROVING QUALITY OF CHEESE MADE FROM MIXED MOLD RENNET EXTRACTS

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Cheesemaking utilizes RENNET from slaughtered young milkfed calves as the source of the enzyme RENNIN to induce coagulation of milk. Rennet SUBSTITUTES such as MOLD EXTRACTS exhibit rennin-like characteristics, producing cheeses of low fat content and better flavor with some molds and high milk clotting activity with others. Improvements in color, texture and general acceptability are also observed. The feasibility of using MIXED MOLD EXTRACTS in cheesemaking has been demonstrated, but the resulting product is marginally acceptable.

This study seeks to improve as much as possible the YIELD, ACCEPTABILITY, NUTRITIVE VALUE and QUALITY of cheese made using mixed mold extracts through the manipulation of extract combinations.

Mold extracts from Aspergillus niger (strain 3704) cultured in potato dextrose agar (PDA) and Czapek-dox agar (CDA); and Rhizopus oryzae (strain 3356) cultured in rice bran (RB) and copra meal (CM) were combined in different ratios, with and without lactic acid from Streptococcus sp.

The Wilcoxon's signed-rank test showed that the most acceptable proportion for cheesemaking is 5.0 CM:5.0 CDA with lactic acid. Its crude fat content (9.42%) ranked highest among the experimental samples and only two percentage points lower than that of commercial cheese. Its crude protein content is 15.18% compared to 18.80% in commercial cheese.

Cost analysis showed that the experimental samples at P14.64/100g and P13.74/100g (treatments with and without lactic acid, respectively) were more expensive than the control sample at P8.00/100g. However, with the use of carabao's milk, costs may be substantially reduced.

#Honorable Mention - American Intellectual Property Law Association

#DISCOVERY OF IMMOBILIZATION SYSTEM FOR FRUCTOSE-1,6-BISPHOSPHATASE: ITS ROLE AS A POSSIBLE PREVENTIVE MECHANISM FOR DIABETES

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Fructose-1,6-Bisphosphatase (FBPase) is one the key enzymes in gluconeogenesis. Without this enzyme, man would eventually perish due to an insufficient amount of glucose.

Trypsin and chymotrypsin are both proteolytic enzymes produced in the intestine. It is known that these enzymes inactivate FBPase by cleaving peptide linkage. Thus, causing a metabolic disorder known as infatile lactic acidosis that may result in diabetes or death.

Chemical and biochemical techniques such as enzyme purification, modification, immobilization, chemical synthesis, assays, and spectrophotometric observations were conducted.

It was found that FBPase can be successfully modified by pyridoxial-P. This modification results in the protection of FBPase against inactivation by trypsin or chymotrypsin. It was also found that FBPase can be immobilized using CNBr-activated polysaccaride, which also results in the protection of FBPase by trypsin or chymotrypsin. These protections suggest that this immobilization technique provides an in vitro mechanism for preventing diabetes, since it has been previously established that the inactivation of chis enzyme by these proteolytic enzymes may cause diabetes. Future studies are intended to create an in vivo approach to the above explained mechanism. This may be possibile through the incubation of a molecule with a strong affinity for the immobilized system and the FBPase to create an automatic in vivo attraction.

#First Award - American Medical Association
First Award - United States Air Force
Second Award - American Intellectual Property Law Association
Honorable Mention - American Chemical Society

THE NEPHROTOXICITY OF AMINOGLYCOSIDES

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Nephrotoxicity has been recognized as a serious complication resulting from antibiotic administration. One of the correlated factors resulting in nephrotoxicity has been the accumulation of gentamicin, tobramycin, amikacin and other antibiotics in the outer cortex of the nephrons. Significant research has been done on nephrotoxicity. Many of the other classes of clinically useful antibiotics can cause nephrotoxicity. These adverse effects on the kidneys are characterized by symptoms such as polyuria, decreased urine osmolality, increased FENa and by progressive azotemia. The factors analyzed to diagnose nephrotoxicity are urine volume, dailyweight, water intake, urine sodium, urine potassium, urine creatinine and urine osmolality. In the study that I carried out last summer, twenty-six male Sprague-Dawley rats divided into three groups were used and three aminoglycosides were studied for a period of ten days each.

MEAT TENDERIZERS: A Study of Enzyme Activity

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Enzymes are protein catalysts found in organisms. They speed up chemical reactions. Enzymes are greatly affected by pH levels and changes in temperature. They also exhibit speificity in that they will catalyze only certain reactions.

The enzymes used in these experiments were not difficult to obtain. Both enzymes, bromelain and papain, were found in meat tenderizers. The purpose of these experiments was to determine some effects of bromelain and papain on protein digestion.

These experiments prove that bromelain and papain are affected by pH levels and temperature. These experiments also prove that the enzymes do show specificity.

BIOSYNTHESIS OF SMALL NUCLEAR RNAs IN CULTURED HUMAN CELLS

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UV radiation induces the formation of pyrimidine dimers in DNA resulting in premature termination of transcription. After irradiation, the inhibited synthesis of large RNAs returns to normal. In the case of small nuclear RNAs (snRNAs), although their synthesis is unexpectedly sensitive to UV, it decreases within 2 hr after irradiation. This suggests that a factor other than the level of pyrimidine dimers is important in the late inhibition of snRNA synthesis. It has been shown that relaxation of torsional stress in DNA results in reduced transcription and is one of the first steps after UV irradiation. Novobiocin and nalidixic acid cause relaxation of torsional stress, while novobiocin prevents DNA relaxation in UV-irradiated cells. If the UV-induced late inhibition of snRNA synthesis reflected hypersensitivity of snRNA transcriptional domains to changes in torsional stress, one might expect that these drugs could have a perferential inhibitory effect on snRNA synthesis in non-irradiated cells or prevent the post-irradiation incubation UV-induced inhibition of snRNA synthesis. The results of this experiment do not support the proposal that the decrease in snRNA synthesis after UV irradiation may be related to hypersensitivity of the snRNA transcriptional domains to changes in DNA torsional stress.

#INHIBITORS OF HUMAN GRANULOCYTE ELASTASE FROM THE LEECH NEPHELOPSIS OBSCURA

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Emphysema is thought to be caused by an imbalance generated through a loss of functional α_1-Protease Inhibitor in the lung and an excess of granulocyte elastase activity. Biological inhibitors of human granulocyte elastase (HGE) could, therefore, serve a valuable therapeutic role in the treatment of emphysema and other disease states related to an uncontrolled elastolysis.

A crude extract of inhibitors from the leech Nephelopsis obscura was prepared by acetone extraction of leeches dehydrated in ethanol then applied to a gel filtration column. Subsequent fractionation of the inhibitors yielded four fractions, two of which inhibited HGE. Characterization of these two fractions showed Fr. I to contain two inhibitors: an antitrypsin molecule and an anti-HGE/antichymotrypsin molecule, both of molecular weight (mw) 7800 (evaluated by SDS-gel electrophoresis). Fr. IV had one inhibitor specific for HGE and another active against chymotrypsin, both of 10500 mw. Calculation of Dissociation constants (K_i) yielded values in the 10^{-9} range for both Fr. I and IV. The two molecules were also found to be stable in the presence of Chloramine T, a mild oxidant similar to cigarette smoke. Fractions II and III, which had no anti-HGE activity, did have a very specific, active antitrypsin peak of 12100 mw and also a strong inhibitor of chymotrypsin (K_i=1.9 x 10^{-10} M).

The Fr. I anti-HGE is very similar to the eglin molecule of the European species Hirudo medicinalis, the only leech of which there are published protease inhibition studies. However, there appears to be another HGE inhibitor in N. obscura which is specific against this enzyme. Both molecules are strong, stable inhibitors of low mw and could serve a very promising role in the treatment of diseases produced by uncontrolled elastolysis.

#First Award - General Motors ISEF
Honorable Mention - American Chemical Society

A COMPARISON OF SUGAR CONTENT IN SOFT DRINKS

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My objective was to compare four major soft drinks and their corresponding diet drinks to find out what percentage of sugar each soft drink contained.

To investigate, I got samples of Coca Cola, Diet Coke, 7-Up, Diet 7-Up, Dr. Pepper, Diet Dr. Pepper, Pepsi, and Diet Pepsi. Since soft drinks contain some sucrose and some glucose, I added hydrochloric acid to each sample to break down all the sugar into reducing sugars. I then added Benedict's solution to each soft drink sample. I made standard glucose solutions in the following amounts: 5%, 10%, 15%, 20%, 25%, and 30%. I added Benedict's solution to these solutions, too. I heated each solution to get the Benedict's to react. I then examined each solution under a microscope. The sugar showed up as black dots. I counted the number of black dots in a 1/8 section of each slide and compared the number of dots in each soft drink to the standard percentages.

My comparisons showed that, in the non-diet area, Dr. Pepper contains approximately 30% sugar; Pepsi contains 30% sugar; Coke has about 25% sugar; and 7-Up has about 25% sugar. I found no black dots in any of the diet drinks.

STUDY ON ARTIFICIAL EMBRYO

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Is it possible to use sea water for cultivating plant tissue? It is my starting point to make an experiment. When I dropped some solution of Sodium Alginate, which is a componet of phaeophyta, into sea water, Icould make a fine coacervatical material. I was very interested in the material and named it "Artificial Embryo." As the next step, I made several Artificial Embryoes in several kinds of metallic salt solution and experimentally made sure of ion going in and out through the membrane of the Artificial Embryoes.

Then I tried to confine same explant of plants, premature embryo and growth point into the Artificial Embryo with embryo culture medium and made those tissue cultures. As the result of growing plants such as lilies, morning-glories, primroses, and alstaomerias, I found they had grown much better than those in agar culture medium. Especially my method is superior at the point of being able to change with new culture medium freely. And when the seeds were confined into Artificial Embryo, it was convenient for water cultivating.

\# THE EFFECT OF CEPHALOSPORIN ON THE CELL WALL OF AGROBACTERIUM TUMEFACIENS

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Strain B$_6$ of Agrobacterium tumefaciens causes crown gall disease in most dicot plant species. Crown gall disease is in many respects an analog to animal cancer and may shed some light on oncogenicity in humans.

Many antibiotics exert their effect on bacteria by interfering with general protein synthesis or by inactivating the enzyme transpeptidase.Cephalosporin antibiotics have been cited to bring about both reactions. Therefore treating bacteria exposed to non-lethal concentrations of Cephalosporin would provide information regarding the peptidoglycan aspect of the bacteria's cell wall. Cells treated with cellulase, an enzyme that digests plant cell walls,would provide data involving the plant cell wall in the recognition phenomenon.

Bacterial infection counts were done using flouresence microscopy and Polyacrylamide Gel Electrophoresis. "PAGE" was a useful method of testing the content of octopine synthase found in each sample. Octopine synthase is an enzyme with a molecular weight of 38,000. In 1979 it was found to be specific only to crown gall tumor tissues.

The data from the bacterial infection tests showed that the the bacteria's inability to regenerate and maintain intact cell walls did affect its infection of plant cells(tobacco).Those bacteria incubated in 0ppm Cephalosporin infected tobacco plants in 84% of the cases as compared to 3% bacteria incubated in 100ppm Cephalosporin. " PAGE" data showed no marked differences between cell and protoplasts content of octopine synthase.

\#First Award - American Phytopathological Society
Third Award - General Motors ISEF

#CARCINOGENIC BY-PRODUCTS IN NITROGEN METABOLISM BY HUMAN INTESTINAL BACTERIA

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The purpose of the research involved the detection and investigation (in vitro) of a carcinogenic nitrogen-to-nitrite conversion reaction by human intestinal bacteria. As this reaction and its reverse were previously detected in isolated strains of Pseudomonas aeruginosa, it was hypothesized that at least one species of intestinal flora (among which the aforementioned bacteria are present) would metabolize N_2 to NO_2^-. To perform an in vitro study, anonymous human fecal specimens were collected and homogenates prepared through dilutions with distilled water; four (4) homogenates were prepared (per sample) and labeled "A", "B", "C", and "D" respectively. Bacteria in both "A" and "C" homogenates were destroyed (as ascertained by blood agar "streak" cultures exhibiting no growth), while bacteria within "B" and "D" samples were allowed to survive. "A" and "B" samples were degassed and exposed to N_2 gas at atmospheric pressure and 37.0°C for 24 hours. "C" and "D" homogenates were subjected to identical conditions but were not exposed to N_2 gas. All samples were tested for nitrite content preceding and following incubations. Through elimination, it was discovered that this reaction, under conditions similar to those encountered in the human body, is conducted by an (as yet) unidentified species of human fecal bacteria in the presence of nitrogen gas. Approximate volumes for carcinogens produced within the intestines were then calculated using ratios from previous research. The detection of this carcinogenic nitrogen metabolism suggests not only a possible cause for the development of cancerous tumors in humans, but also an evidently negative effect of the administration of the routine anesthetic/analgesic nitrous oxide. Further research will determine the acceptability of nitrous oxide for human treatment.

#Fourth Award - General Motors ISEF

PHEROMONES: COCKROACHES TRAPPING COCKROACHES

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One of our society's greatest problems is the danger of pesticides. These synthetic chemicals often have detrimental, even lethal, side-effects; the incident in Bhopal, India, and the plight of the American bald eagle are two tragic examples. The purpose of this experiment was to devise alternate schemes of cockroach control through the use of naturally produced chemical attractants called pheromones. Through the utilization of such chemicals, cockroach populations could be isolated in a given area and exterminated with local poisons, thus reducing the potential for affecting non-target organisms.

Two groups of pheromones of the American cockroach were used in this investigation: the aggregational pheromone and the sex pheromone. The structural designs of the various portions of this experiment allowed study of the effects of the aggregational and sex pheromones as well as the relationship between both.

Several substantial conclusions can be drawn from the results of this experiment. The first is that the pheromone induced mass aggregations of the vast majority of a given cockroach population and that external variables never had sufficient power to override that of the aggregational pheromone. The second was that while sex pheromones were successful in affecting isolated individual cockroaches, they were not successful in shifting the location of a given pheromone-induced mass aggregation. Finally, the aggregational pheromone of the American cockroach was proven to be interspecific as significant numbers of other cockroach species were also attracted.

#BIOCHEMICAL ASSAYS FOR THE ANTI-CONVULSIVE PROPERTIES OF ERYGIUM FOETIDUM (L.) (POLAR CONSTITUENTS).

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The plant Erygium foetidum (L.) grows wild in Puerto Rico. It is known as "culantro". It is very popular as a food seasoning. In Jamaica, popular belief recognizes E. foetidum as an anti-convulsive. The present investigation attempts to study and analyze its pharmacological properties. Emphasis will be placed on toxicological levels and anti-convulsive properties.

Aqueous and ethanolic extracts activity were tested. A Brine Shrimp Test was used to analyze toxicity and Pentylenetetrazole Mouse Model Test was used to induce convulsions and test protection levels. The toxicological tests demonstrated a high mortality percentage in ethanolic extract, while the infusion showed low mortality percentages. High anti-convulsive protection levels were obtained by injection of an infusion solution, while the ethanolic extracts showed no protection activity.

The histological study showed no effect of the infusion on the cells studied.

#Third Award - General Motors ISEF

A TALE OF TWO GASES

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The purpose of this research was to estimate the number of lives lost or shortened by a plutonium leak in comparison to the methyl isocyanate leak in Bhopal, India, in December.

A computer program was written to find the diffusivity of the two substances in air, which was multiplied by the number of hours the substances escaped and the wind factor, finally, calculating the number of square miles they spread before diffusing.

The population, geography, and diffusivity were taken into account in the estimating of the maximum number of inhabitants that would feel death or a shortening of life. Twenty-five years after the leak an estimated 750,000 inhabitants will be able to contribute their death to cancer caused by the plutonium leak; an estimated 150,000 inhabitants will feel death caused by methyl isocyanate. With plutonium a vicious cycle develops, in that the dead are burned or buried and the plutonium particles are released again and again to be reinhaled. Plutonium, also, contaminates the water.

SYNTHESIS OF CHOLESTEROL ESTERS IN ATHEROSCLEROTIC PLAQUE

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Cholesterol and its use in the human body has been a subject of growing controversy in recent years. Cholesterol is a substance with a vital importance to the human body. Used to form cell membranes, bile acids, and hormones, cholesterol is held in a delicate metabolic balance. The body must maintain just enough cholesterol to serve its needs, but excess cholesterol results in the formation of plaque in the arteries that causes angina, stroke, and heart attack. This disease, called atherosclerosis, strikes more frequently with today's Western diet. A striking feature of atherosclerotic plaque is a core containing massive amounts of cholesterol esters. The purpose of this project is to synthesize the cholesterol esters found in atherosclerotic plaque. This project is a step toward researching the possibility of a substance that may dissolve the core esters and therefore halt plaque formation.

THE ACTIVITY OF LIPOXYGENASE DURING THE GERMINATION PROCESS OF LEGUMES

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The role of lipoxygenase, an enzyme found in legumes, is little understood. One plausible hypothesis suggests that lipoxygenase (LOX) may be the initial member of an enzyme system which provides energy for the germination process. The purpose of this study is to examine the validity of this hypothesis through observation of lipoxygenase activity.

Over a three year period, a variety of experiments have been conducted using two types of legume plants--Bragg soybeans and California black-eyed peas. In the first year, LOX activity in Bragg soybeans was measured using plants which were grown in the light and in the dark in controlled environments, and harvested at different stages of germination. In the second year, a more accurate measuring procedure was applied to California black-eyed peas to check the accuracy of the previous year's findings. In the third year study, observations were made of the products of the lipoxygenase reaction, lipo-hydroperoxides, at varying stages (marked by different lengths of time) of the lipoxygenase reaction. These observations were made using different concentrations of two types of enzyme extraction.

The following results lend support to the hypothesis that lipoxygenase plays a role in the supply of energy for germination in legumes: the enzymne is more active and potentially supplies more energy at the initial stage of germination when there is no energy provided by photosynthesis; the enzyme activity decreases as the germination process progresses and the energy supplied by photosynthesis increases; greater enzyme activity is observed in plants grown in the dark and deprived of the energy source provided by photosynthesis.

As the lipoxygenase reactions progresses, the level of hydroperoxides increases and then decreases. This decrease indicates the possible presence of a second enzyme which is reacting with the products of the lipoxygenase reaction. Thus, the likelihood of the existence of the hypothesized enzyme system has been increased.

#REGULATION OF PRO-OPIOMELANOCORTIN GENE EXPRESSION IN RODENT TESTES

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Disorders such as male hypo- and hypergonadotrophic syndromes are generally treated with testosterone therapy or administration of human chorionic gonadotropin (hCG). In order to gain greater insight into the intricate interactions and consequences of altering specific hormonal levels, the influences of androgen, gonadotropin and glucocorticoids on the gene expression of a peptide hormone system, pro-opiomelanocortin (POMC), werestudied. Messenger RNAs which code for this polyprotein precursor have been identified in the pituitary and recently located in testicular Leydig cells. Intact testicular samples were exposed to adrenalectomy, hypophysectomy coupled with hCG, and testosterone. Total cellular RNA and polyadenylated RNA were isolated, quantified, and characterized by Northern blot analysis and a POMC cDNA probe for detection of any alterations in POMC mRNA levels.

The major discoveries of this investigation were that 1) neither administration of exogenous testosterone or removal of endogenous glucocorticoids affect POMC mRNA levels whereas, 2) hCG clearly maintains testicular weight and stimulates RNA content in the testes of hypophysectomized rats. It was suggested that hCG regulates POMC gene expression in the Leydig cells of rodent testes. It was also shown that the POMC mRNA:poly (A)+ RNA ratio is much greater in the adult mature testes than in the prepubertal testes. Hence, POMC may serve as a model system for the study of gene expression in the Leydig cells.

#Second Award - General Motors ISEF
Honorable Mention - American Chemical Society

#CLONING HEMIN AND NAD INDEPENDENCE IN HEAMOPHILUS INFLUENZAE

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All living organisms require some form of energy for survival. Not all of these organisms, however, are capable of the biosynthesis of the required cofactors necessary for the utilization of this energy. For instance, hemin is a very important cofactor for many enzymes. It plays an active role in electron transfer in the creation of ATP. Heamophilus influenzae is one bacterium in particular that is incapable of biosynthesizing both hemin and NAD which are necessary for normal cellular respiration. This project involves an attempt to clone the hemin or NAD genes into H. influenzae thereby making it independent of these required suppliments.

The cloning vector (or vehicle) used in gene splicing was a small plasmid taken from a strain of H. influenzae that was resistant to the antibiotics ampicillin and tetracycline. Plasmid AT4 was carefully chosen because it possessed these selectable markers that would be useful in cloning. A restriction enzyme is used which permits insertion of the new gene into the vector, resulting in loss of ampicillin resistance. After the new gene has been inserted into the cloning vector (pAT4) this plasmid is transfered to a host organism via genetic transformation. If the attempton gene splicing was unsuccessful and transformation occured the recipient organism of this plasmid will express resistance to both ampicillin and tetracycline. However, if transformation was unsuccessful then the host will not express resistance to either antibiotics. By choosing a restriction enzyme in conjunction with a cloning vector an attempt was made at cloning hemin or NAD independence in Heamophilus influenzae.

#Fourth Award - General Motors ISEF

INHIBITION OF POLYMORPHIC FORMS OF CHOLINESTERASE IN Mus musculus AND Peromyscus leucopus MICE FOLLOWING TREATMENT WITH ORGANOPHOSPHORUS INSECTICIDES

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Organophosphorous insecticides are effective because they bind to cholinesterase (ChE). Therefore ChE's are unable to degrade GABA (a neurotransmitter in insects similar to acetylcholine). This kills the insect through overstimulation of its neurons. These organophosphorous insecticides also toxify mammals through modes of action similar to those in insects. This project was done to compare the relative proportions of ChE activity found in membrane-bound and freely-soluble (synaptic) forms, to separate out different molecular weight forms of ChE, and to compare the effects of organophosphorous insecticides on a laboratory species (Mus musculus) with a wild species (Peromyscus leucopus).

Five experimental mice from each species were given sub-lethal doses of parathion (an organophosphorous insecticide) orally. Five control mice from each species were given corn oil orally. Ellman assays (Ellman et al., 1961) for ChE activity were performed on homogenate brain tissue.

There was no significant difference found between the membrane-bound and freely-soluble forms. Two molecular weight forms were separated using a sucrose gradient, LDH assays, and ChE assays. Levels of ChE were lowered in treated mice from both species to about the same extent.

HYDROLYSIS OF CELLULOSE FROM BIOMASS

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Cellulose is the chief ingredient of the plant cell wall and the most abundant organic compound. A polysaccharide and polymer of beta D-glucose, cellulose can be broken down by hydrolysis with an acid or an enzyme. Commercial hydrolysis of cellulose for production of glucose has become a more active field of research in recent years. The coupling of cellulose hydrolysis with biomass as feedstocks represents an exciting new technology since biomass is a renewable resource.

To compare the feasibility of various biomass feedstocks, two sources, i.e., wood products and agricultural products were hydrolyzed and the potential of fermentable sugars measured. The wood products used were oak, pine, and alder sawdust. The agricultural products used were barley, bean, and wheat straw. Cotton was used as an almost pure cellulose source.

The procedure used is commonly known as the heavy acid method. The biomass sources were initially hydrolyzed with 72% H_2SO_4 (sulfuric acid), diluted to 4% H_2SO_4, and cooked for 1 hour at 15 psi. The recovered residues were rehydrolyzed to measure the completeness of the first hydrolysis. The final products were dried and weighed to determine the percentage of lignin. The hydrolysates, first and second hydrolysis, were analyzed for glucose content with the glucose oxidase assay, using a Spectronic 710.

It was predicted that the wood products would give higher yield of fermentable sugar than the agricultural products. The results of the experiment verified this prediction. The sugar produced from large scale cellulose hydrolysis could have almost infinite possibilities, especially in the food and fuel industries.

TOXICOLOGICAL EFFECTS OF SIX COMMON PESTICIDES ON MUS MUSCULUS

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The purpose of this study was to find and record the effects caused by prolonged exposure to six common pesticides (Lasso, Bicep 4E, Dual, Treflan, Ordram 8E, and Penthion 4E). 24 mice of the species Mus musculus were grouped into six groupings of four mice per group. A specific pesticide was applied to each group for a period of seven days. A control set of eight mice lived under the same conditions except for the application of a pesticide. After seven days of application, the mice were sacrificed; blood and selected organ tissues (liver, spleen, heart, and kidney) were analysed. Two pesticides, Lasso and Bicep, were found to cause drops in both the pH and hemoglobin levels. The Lasso treated group had a pH level of 6.8 and a hemoglobin level of 5,5 mval 9.0g%. The Bicep treated group had a pH level of 6.9 and a hemoglobin level of 4,8 mval 8.0g%. The correlation coefficients between the pH and hemoglobin levels for the Lasso and Bicep were found to be 0.633 and 0.853, respectively. The chi square values for the hemoglobin drops for Lasso and Bicep were found to be 12.73 (<1.00) and 17.58 (<1.00), respectively. Bicep treated mice were found to have blood present in unusually high amounts in the liver, kidney, and spleen. This presence may have been caused by the apparent bursting of capillary walls. Acidosis may have been caused by kidney shutdown or adverse effects which may have been caused by the pesticides on the bicarbonate buffer system of the blood.

#EFFECT OF DIAZIQUONE ON THE STRUCTURE OF DNA

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Diaziquone (AZQ), a quinone-containing chemical compound, is known as an effective anticancer drug. Although it is known to interact with cellular deoxyribonucleic acid (DNA), the exact mechanism by which that interaction takes place is not clear. In the treatment of cancer, various chemotherapeutic agents have been useful because they are known to interact with the DNA molecules. Recently, it has been shown that AZQ can be activated by sodium borohydride ($NaBH_4$) which then cross links between DNA and protein molecules, causing single and double strand breaks. In this study I have used a much simpler method to investigate the effects of AZQ (reduced with $NaBH_4$) on three forms, supercoiled (Form I), open nicked circular (Form II), and linear (Form III), of bacteriophage PM-2 DNA. The supercoiled DNA may be nicked, forming a relaxed circular DNA or it can be cleaved, forming linear molecules when exposed to reduced AZQ. The structural changes of the DNA can be monitored by using a method of electrophoresis in agarose gels. From the data collected in this experiment, I found that under ordinary conditions, neither AZQ nor Thio-TEPA, a related drug, altered the mobilities of the topoisomers of PM-2 DNA. But under the influence of a reducing agent, sodium borohydride, the reduced drugs predominately introduced single strand breaks in the supercoiled (Form I) PM-2 DNA forming nicked relaxed circular (Form II) DNA. It is expected that studies of this nature will help elucidate how antitumor drugs interact with DNA.

#Third Award - American Chemical Society
Fourth Award - General Motors ISEF

THE KINETICS OF VIBRIO HARVEYI INTERMEDIATE II DECAY

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Bioluminescence is the phenomenon in which organisms generate light through a chemical reaction. The luminous organism this project deals with is a bacterium called Vibrio harveyi. The chemicals Vibrio harveyi uses to produce light are $FMNH_2$, O_2, RCHO, and an enzyme called a luciferase. The reaction proceeds through 3 stable intermediates, called INT I, II, and III. INT II decomposes spontaneously via a first order process.

A standard assay is done by injecting $FMNH_2$ into a vile containing RCHO, enzyme, O_2, and buffer(pH 7). An INT II assay is done by injecting INT II solution into RCHO and buffer. In all assays light intensity is detected by a photomultiplier and is recorded as a function of time. In each assay light rises to a maximum intensity, called I_o, and then decays via a 1st order process. The log of light intensity during the decay is graphed as a function of time.

In a standard assay, this graph represents a straight line throughout most of the decay. But at the very end, the slope drops. INT II assays done with a fresh sample of INT II exhibits this same result. However, when the sample of INT II ages, the graph remains a straight line all the way through the assay. This graph also has a lesser slope. INT II assays done with Vibrio fischeri bacteria have been known to exhibit a double peak; light intensity rises to I_o, falls, rises, and finally falls again. The conclusions from these results are that there are more than one type of luciferase in a species of luminous bacteria, and INT II molecules which decompose faster are also more rapid in going through the light-producing reaction.

THE RABBIT TEST: PHASES III AND IV

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The Rabbit Test : Phase III; The Use of Commercial Oral Steroid Treated Vegetation to Inhibit the Reproductive Abilities of Female Rabbits. Phase IV; The Effects of Oral Steroids Induced During Gestation upon the Second Generation Male Offspring's Reproductive Abilities.

The Reproductive capabilities of some animals can have disasterous effects upon their environment. The ultimate objective of experimentation is to find a feasible method of controlling destructive animal populations in the wild. Earlier experimentation has supported the idea of using oral steroids to control the populations of animals, with surprising results such as all male births.

Phase III concerns itself with using known effective oral steroids in relative concentrations to treat vegetation on a cyclic basis, and subsequently administering it to female rabbit population as a method of birth control, while the females are mated on a similar cyclic basis. Phase IV is an appendage of Phases I and II. Wherein the reproductive abilities of male offspring resulting from insufficient dosages of oral steroids administered during gestation.

The steroid treated vegetation was effective as a means of birth control. All females receiving treated vegetation were not impregnated throughout three mating cycles. The second generation male offspring were capable of reproduction, however; reproductive capabilites were limited; only a few offspring per litter were produced by the experimental males. Control females had live healthy litters of both sexes.

#First Award - United States Army

PHYSIOLOGICAL EFFECTS OF CHEMICAL SUBSTANCES PRESENT IN IPOMOEA TILIACEA IPOMEA POLYANTHES, PASSIFLORA, EDULIS, AND SECHIUM EDULE IN PHASEOLUS VULGARIS PLANTS.

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The purpose of this investigation is to determine physiological effects of substances extracted from apexes of Ipomoea tiliacea, Ipomoea polyanthes, Passiflora edulis and Sechium edule when applied in lanolin paste and compare it with effects of known phytohormones.

If substances extracted from these plants produce physiological effects to Phaseolus vulgaris plants; their development will be different to that of control group.

A dough prepared with lanolin and the extract obtained putting apexes in ethylic alcohol was applied to the stems. Lanolin is applied to the experimental group.

In the experimental group growing inhibition and bulky stem were observed. The control group had faster growing, enlargement of stem diameter and variation in number and size of grain, pods and flowers.

A solvent partitioning purification fractionation was done with extract of Passiflora edulis using chlorometane, methanol, hexane, carbon-tetrachloride and chlorom as solvents. With the six layers obtained a dough of lanolin was prepared and bioassay was done applying the dough to the stems of the plants.

Fractions obtained produced growth inhibition and enlargement of stem diameter. Flowers, pods,grains and greater development of roots were produced with the dough of C C/4 layer.

Extract of Passiflora edulis will be analized using a gas cromato graph adapted to a mass spectometer (Model Hewlet Packard 5995 A)

The results made me conclude that this extract may contain phytormones.

#SPINAL RELEASE OF IMMUNOREACTIVE MET-ENKEPHALIN BY INTRAVENTRICULAR β-ENDORPHIN AND ITS ANALOGS IN ANESTHETIZED RATS

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Problem: To discover the mechanisms of analgesic drugs. To do this, I tried to find if Met-Enkephalin was specific to β-Endorphin by using different opiates with different opioid receptors to see if they would release Met-Enkephalin.

Procedure: Rats were anesthetized to expose the cisterna so a cannula could be inserted through the subarachnoid space. An outflow cangula drew the perfusate and morphine, D-Ala^2-D-Leu^5-Enkephalin, U-50488H, or β-Endorphine was injected after 30 minutes of perfusing. The radioimmunoassay method was then used to determine the quantity of Met-Enkephalin that was present.

Conclusion: Met-Enkephalin is specific to B-Endorphin through activation of the epsilon opioid receptor because other opiates with different opioid receptors were unable to release Met-Enkephalin.

Application: This could be the key to finding a drug which uses the analgesic effect but not have any of the ill side effects current analgesic drugs have, such as addictiveness. Current analgesic drugs activate many opioid receptors but if we could activate only the epsilon opioid receptor, we would thus eliminate most of the problems associated with analgesic drugs.

#Third Award - General Motors ISEF

MEASURING PRIMARY PRODUCTION: A STUDY OF OXYGEN CONCENTRATIONS

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The purpose of this experiment is to determine the net and gross photosynthetic rate of phytoplankton by measuring the rate of oxygen production and carbon dioxide consumption, and to determine the effect of graduated light deprivation. An additional purpose was to verify the Winkler assay.

Primary production of seawater samples with their natural phytoplankton populations was determined using the Light and Dark Bottle Technique with 1' graduations of depth. Through the Winkler assay, the oxygen concentration for each sample was measured. Respiration was computed by measuring the decrease of dissolved oxygen in the dark bottle sample by contrasting it to the initial oxygen concentration. Net primary production of each sample was calculated by determining the amount of photosynthetically produced oxygen: light bottle oxygen concentrations less initial oxygen concentration. Finally, gross primary production at any depth was estimated by combining the net primary production and the plant respiration.

This study shows that as the depth of water increases, that is as light deprivation increases, the phytoplankton produce photosynthetically fewer amounts of oxygen. At the same time, these phytoplankton continue to use oxygen for cellular respiration. The result is a curve which demonstrates the contrast between the higher amounts of oxygen produced at or near the surface to the relatively smaller amounts produced at greater depths. In addition, the underlying chemical theory for the Winkler assay was verified through formulation of its chemical equation and by following the transfer of electrons through its reactions.

#EVIDENCE THAT THIOREDOXIN IS REQUIRED FOR BINDING OF GLUCOCORTICOID RECEPTORS TO DNA

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Glucocorticoid steroids cause their effects by binding to a specific receptor located in the cytoplasm, and the steroid-receptor unit is then transformed to a form that binds to DNA and causes the synthesis of mRNA. The mechanism of this transformation is unknown. The purpose of this project is to see if any cytosol factor or enzyme is required to let receptors bind to DNA. Cytosol was prepared from the livers of adrenalectomized rats and the steroid receptor was identified by its ability to bind (^{3}H)triamcinolone acetonide in a manner that is blocked by a high concentration of nonradioactive dexamethasone. The (^{3}H)triamcinolone acetonide-receptor unit was separated from smaller cytosol components by filtering it through a column of Biogel A5M. Unlike the unpurified receptor, the Biogel purified receptor is no longer transformed to the DNA binding form when it is incubated at 20°C. The DNA binding form is assayed by determining the ability of the receptor to bind to DNA-cellulose. If boiled rat liver cytosol is added to the Biogel purified steroid-receptor complex, the receptor then binds to DNA. The component of boiled cytosol that is active has a molecular mass between 2,000 and 20,000 daltons by Sephadex column separation. Rat liver thioredoxin that has been purified to 80% of homogeneity allows DNA binding in the same manner as the endogenous activating factor. Thioredoxin is a heat-stable reducing protein with a molecular mass of 12,000 daltons that is present in all cells. These experiments give strong evidence that thioredoxin is required for binding of the glucocorticoid-receptor complex to DNA.

#First Award - General Motors ISEF

#OPTIMIZING RATE AND QUANTITY OF HYDROGEN PHOTOPRODUCED BY MARINE ALGAE

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This research concludes the second year of a two year study to determine first, if it is possible to use various marine algae as potential sources of hydrogen production and, then, to maximize production quantities and reduce the time necessary to produce the gas.

In Phase I, conducted in 1983, it was determined that green algae varieties were most productive. Maximum production in Phase I that could be confirmed as hydrogen was 4.5ml produced in a three hour period of time. Phase II testing, conducted in 1984-85, was limited to green varieties. The algae were collected from Cedar Key to Marco Island on the West Coast and from Fort Pierce to Key West on the East Coast of Florida. More than 30 samples (12 different variety) were collected from 23 different locations over 2100 miles during a six week period of time. To date, four different varieties have produced a gas in quantities of more than 30ml in one hours time which has been confirmed as containing the presence of hydrogen by two different identification methods. As many as four different tests were conducted to confirm results. Thus far, 23 of 67 tests have confirmed hydrogen by at least one test. The quantity has been improved by six times and the production time cut by two thirds. There are four main reasons for this dramatic improvement. Phase II quantities are 10 to 15 times greater than those used in Phase I; the production system is streamlined to allow a more free flow of gas; light intensity has been increased; and, Phase II testing concentrated on the light phase of the photosynthetic reaction. Many questions remain, however, utilization of marine algae has many positive advantages as an alternative energy source and there are certainly no more disadvantages than other energy alternatives being considered.

#Honorable Mention - U.S. Department of Energy

#THE DIRECT QUALITATIVE EFFECTS OF INSULIN ON BASEMENT MEMBRANE PROTEOGLYCANS

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Previous research was performed to determine the effects of insulin treatments on basement membrane proteoglycans in order to establish key factors in the prevention of long-term diabetic complications. The EHS tumor was used as a model of basement membrane component synthesis within streptozotocin-induced diabetic C57 Black mice and control animals. The studies showed a significant increase in the net charge of the basement membrane proteoglycan molecules eluting from the columns due to the insulin treatment regimems.

The current research attempts to answer the question of whether the insulin was directly affecting the cells or was indirectly affecting them by causing a physiologic change in the state of the animals, which, in turn, altered the proteoglycans. To perform these studies, EHS tumor tissue from a C57 Black mouse was acquired. The tissue was disrupted by passage through several screens, and the matrix material surrounding the cells was broken down by a dispase procedure. The disassociated tissue was then passed through a sterile Nitex filter, and the resulting free cell suspension was quantitated. Approximately 75,000 cells were placed into each well of multiwell culture plates. The media in the wells contained varying amount of insulin. After being radiolabeled with ^{35}S-sulfate and ^{3}H-proline and incubated for 24 hours, the samples were dialyzed. Qualitative analyses were then performed by chromatography on DEAE ion-exchange columns.

Based upon the experimental data, which showed no change in the charge of the molecules, insulin had no direct qualitative effect on the proteoglycans of the basement membrane.

#Third Award - General Motors ISEF

TWO YEARS OF BENZO(A)PYRENE: EXPLOYING THE TECHNIQUES OF PHOTOSPECTROSCOPY AND HIGH-PRESSURE LIQUID CHROMOTOGRAPHY

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The subject of the metabolism of the carcinogenic aromatic hydrocarbon 3,4-benzo(a)pyrene has recently gained more and more attention from the scientific community. One reason for this is the fact that 3,4-BP is a known constituent of tobacco smoke. For years, scientists have found that the metabolism of 3,4-BP into its electrophilic ultimate carcinogen takes place primarily in the lower lungs, then eluding into surrounding tissue. This project proposes that the metabolism begins in the saliva; if this hypothesis is true, one should find metabolic forms of BP in the saliva of cigarette smokers. To detect these metabolites, .01g and .001g of BP were cultured with 1ml each of a non-smoker's saliva in a culture incubator for 61 hrs. Similarly, two samples of 30 cc's of smoke from a single cigarette were cultured with the same amounts of saliva from the same non-smoker. The cultures, as were ten non-smoker and twenty smoker samples, were subjected to photospectroscopic testing (0-1A; diluted 30 mic-l to 400 mic-l). Subsequently, the samples underwent HPLC using a Dupont Zorbax ODS column (MeOH:H_2O...30:70 and 70:30). The photospectroscopy proved to be inconclusive. The HPLC showed peaks similar to peaks in a Selkirk study of rat liver microsomes. The peaks were prevalent in the smoker samples, leading to the belief that these two peaks represent the 9-OH metabolite and 3,4-BP itself in smoker's saliva. The presence of BP and this primary metabolite suggests that BP metabolism begins in the saliva, using that medium as a vehicle for carcinogenic metastasis

BOTANY

#ALLELOCHEMICS OF BROOM SNAKEWEED

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Broom snakeweed (Gutierrezia sarothrae) has been proven to be an allelochemic plant. It produces and/or emits chemical(s) that destroys other competitive plants. This investigation seeks to define physical and/or chemical properties of these allelochemic substances(s) in order to provide direction for extensive research to isolate the allelopathic agents.

Testing areas to identify these specific chemical and/or physical properties included: sulfuric acid and/or potassium hydroxide treatment —to neutralize or tie-up the compounds; centrifuging—to prove it is a true solution; volatile gas effects; a chromatography study; and infrared spectrometer testing.

The acid-base treatments were eliminated as a possibility.

Volatile gasses proved to be an area containing some of the allelopathic chemicals that effect radicle growth; therefore this is an area to be further tested.

Centrifuging proved the compound was in true solution, but surprisingly decreased germination. This area needs further testing.

Paper chromatography showed definate division when observed under a blacklight. It was determined that sec.-butyl:acetic acid:water (2:1:1), sec.-butyl:ethanol:water (27:3:10), and ethanol:water (10:10) solvents gave the best divisions.

Seeds planted on the chromatogram sections showed that probably several different allelochemic substances are effecting the seeds because of the varied effects.

Infrared spectrophotometer testing on chromatogram sections, that had the most effect on the seeds, showed isolation of a single compound was not complete, but several specific compound groups were identified for further testing.

#Third Award - General Motors ISEF

EFFECTS OF CHEMICALS ON ROOT GROWTH AND GEOTROPISM

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This project is concerned with the effects of gravity and chemicals on geotropism and root growth. Corn seeds, soaked in water over a period of twenty-four hours, were placed uniformly on moist paper towel. After the seeds sprouted, the petri dishes were divided into four sets, each containing four petri dishes. In each set, two of the dishes contained 'capped' roots and the other two contained 'decapped' roots. Of the four sets, one was used as a control. In each of the other sets, three different chemical salts, calcium chloride, potassium chloride and sodium chloride were applied to the top and bottom of the root tips of both capped and decapped roots. The solution of the chemicals was prepared by dissolving one gram of solute into ten millimeters of water, thus creating a 0.1% concentration w/v. The petri dishes were inverted at ninety degree angles every twenty-four hours. The effects on root growth and geotropic response were then studied. Results showed that different chemicals affected root growth and geotropic response in different ways.

#PROTOPLAST FUSION OF SUNFLOWER AND SUNFLOWER TUMOR TISSUE

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Protoplast fusion is the combining of two plant cells into one functional cellular unit. Through enzymatic digestion the cell wall is broken down, leaving a "naked cell." Because of osmotic pressure, these cells freed from the restraint of the cell wall, would burst unless the medium has an osmoticum--usually mannitol, sorbitol, or glucose--added.

I used tumor tissue initiated by the soil bacterium Agrobacterium tumefaciens. This cancerous growth is know as crown gall disease, which is characterized by large, autonomously growing masses of cells on the plant's roots or stem. This neoplastic strikingly resembles animal cancer. It crushes and alters the free flow of nutrients to the upper part of the plant. The slow cut-off of nutrients eventually kills the plant.

Individual cells of healthy sunflower (Helianthus annuus) and diseased sunflower were isolated and converted into protoplasts. The protoplasts were washed from the enzyme and combined. The mixture of protoplasts was subjected to polyethylene glycol (PEG) which caused the protoplasts to clump. The PEG solution was diluted with liquid medium at five minute intervals. The clumped cells were then centrifuged, the centrifical force aiding the fusion process. The protoplasts were resuspended in an appropriate medium and incubated at 28°C for one day.

The purpose of my work is to demonstrate how unlike plant cells can be combined to produce hybrid cells(heterokaryons), which can be transferred from liquid to solid media and nurtured into new varieties of plants. Plants which are sexually incompatible can now be hybridized by the fusion of protoplasts, making it possible to produce new varieties which can hopefully improve the quality of man's life.

#Fourth Award - General Motors ISEF

GENETIC ENGINEERING

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This is an experiment in genetic engineering, using X-radiation as a mutagen in an attempt to develop a permanent mutation. Currently in its third generation, the hybrid sweet corn, Pennfresh ADX, had been subjected to variables of radiation and herbicides and permitted to grow in an uncontrolled environment. Fertilizer was applied in all generations as recommended by Pennsylvania State University.

Three groups of 150 kernels were irradiated by a linear accelerator at levels of 22,000, 38,000 and 55,000 rad. Herbicides were then applied to half of each group. The 55,000 rad group died. All corn grew better with herbicides. The irradiated corn had defects.

The irradiated kernels from the first or p generation were used for the f_1 generation. Both 22,000 and 38,000 rad kernels were used. During the year, 1983, a drought killed most of the control corn. By contrast, the irradiated corn grew relatively well with the 22,000 rad growing the best. The 38,000 rad had the most deformities. Kernel shapes were varied - round and flat.

In the 1984 f_2 generation, there were 7 groups: control with and without herbicides; 22,000 rad with and without herbicides; 38,000 rad with and without herbicides; 38,000 without/with herbicides. The average stalk heights were larger than previous years. Multiple ears in all irradiated categories exceeded 50%, with the 38,000 rad having up to a 65% mutation rate. Most multiple cobs contained 3 ears on each cob and some stalks had 2 sets of multiple ears on each cob. All people that ate the corn agreed it tasted as good as or better than the control. Both the 22,000 and 38,000 rad groups froze as well as the control.

COMPARATIVE STUDY OF THE FERTILIZER EFFECT OF SOME MARINE ALGAE IN THE GROWTH AND DEVELOPMENT OF THE "Cajanus Indicus" AND "Capscicum Anuumm"

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Monte Verde #11, Peñuelas, P.R. 00724

The objetive of this investigation is to determine the use of marine algae as a fertilizer for the plants, focusing the study in the growth and development of the Cajanus indicus and Capscicum anuumm. In this experiment the following algaes were used: Ulva lactuca, Codium isthmocladum, Halimeda opuntia, Caulerpa racemosa, Caulerpa verticillata, Enteromorpha intestinalis, Cladophora fascicularis that are part of the divison Chlorophyta; Padina gymnospora and Dictyopteris delicatula that forms part of Phaeophyta division; and Acantophora specifera that forms part of Rhodophyta division. A total of twenty-four recipients were used, each container measured 76 cm. long by 38 cm. wide; twelve with Cajanus indicus and twelve with Capsicum anuumm. To prepare the recipients with the algae, we placed a layer of algae, and another layer of sand; that were lift for three weeks so that the algae will discompose. Two controls were kept; one with sand only and the other with fertile soil. Fifteen plants were planted in each recipient at the same distance and under the same environmental conditions. The results of the Cajanus indicus plants in the three best results are: Ulva lactuca-60.8 cm., Codium isthmocladum-59.1 cm., and Enteromorpha intestinalis-54.7 cm., while the control soil with sand-30.9 cm., and the fertile soil-33.5 cm. The results of the Capsicum anuumm plants in the three best results are: Ulva lactuca-38.9 cm., Codium isthmocladum-37.1 cm. By this, I conclude that different marine algae serves as fertilizers for plants. In the near future they could be used in great amount as an essencial product for agriculture.

NEW CULTURE MEDIA THAT ACELERATES THE DEVELOPMENT OF DIONAEA MUSCIPULA

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The Dionaea Muscipula is one of the most known carnivorous plants This plant has capture the attention of botanits an investigator who have conducted studies to obtain the best methose of cultivation and development of like plant. An example of this is are the differents culture media created. Of these culture media already established, the most effective is the Sundew which develops the roots from 15 to 20 days.

In this investigation the form of reducing the time it takes Dionaea Muscipula to develops it's roots. To was found achieve the above exposed a culture media in vitro was prepared. Supplies the plant witch the plant with the necesary nutrients and contains growing hormones that accelerates the development of the plant. This culture media is called AZ_1. For the experiment I used the Plant tissue culture techniques and the aceptic manipulation for contamination control. The plants were under similar physical conditions of pH, temperature, energetic cycle and period of experimentation. Upon completing the experimentation I found.

The plants that were planted in the culture media AZ_1 showed a pattern of root development more rapidly during the first 10 days of experimentation (14.2%) with relation to the ones that were already planted in murashige's media (0%) and Sundew (0%). This pattern of development was maintained for all the experiment, but during the last 20 days, the culture media AZ_1 produced a 57.14% of roots, the murashiges a 0% and the Sundew culture media a 42.25% of roots.

FACTORS AFFECTING THE GROWTH OF GERANIUM CELLS IN VITRO

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Stem explants from Pelargonium Hortorum were grown on solid media in Erlenmeyer flasks. The influence of napthalene acetic acid and coconut milk on cell proliferation was investigated. Results indicate that napthalene acetic acid is an essential growth regulator for the growth of geranium cells in vitro.

HORMONAL REGULATION OF CHLOROPHYLL LEVEL IN SENESCENT PLANTS

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Senescence is the process of ageing.Relatively little is known about its course in plants. It is suspected to be a hormonally regulated process; thus the choice of hormones for the study. In addition,chlorophyll degradation is the process most indicative of the progress of senescence.

Before the test experiments were conducted, the methods of Thimann and Sachs were reproduced for Kinetin. This reproduction was done to insure the accuracy of the experimental data. The test hormones were Phenidone and Pyrazon. Their effects on oats were unknown.They were found to have a preservative effect with Carnations.

Phenidone and pyrazon were found to retard senescence. They caused a larger chlorophyll retention than the control across a period of seven days. Three replicates of five oats each were performed for each concentration(15 leaves/data point;300 leaves total).

ALLELOPATHY - CHEMICAL WARFARE IN PLANTS

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Many interactions of attack, defense, and behavioral response in the plant kingdom involve chemicals which when secreted by a plant influence the growth, health, behavior, or population of surrounding plants. The purpose of this project was to determine if various spices, walnut meat, and sunflower seeds would inhibit the growth of surrounding plants by secreting a toxic substance. Five experiments using fifteen varieties of seeds were set up. In the first investigation, 0.5g of a spice was placed in the center of a dish and ten seeds were planted 2 cm from the spice. In the second investigation the seeds were placed 1, 2, and 3 cm from the spice. In the third investigation the spice sat in the dish overnight and was removed the next day. The seeds were then planted on the towels containing the toxic substance. In the fourth and fifth investigations twenty-five grass seeds and 0.5g of walnut meat or ten sunflower seeds were placed in a half cup of water. All plants tested showed a significant change in their growth, health, behavior and population. This shows that certain plants do influence other plants by secreting a toxic substance. And so the plant world involves the coexistence of diverse species that survive through a balance of defense systems. Allelopathy is a rapidly growing field, and this insight into the survival technique of plants will have a profound effect on agriculture in the future.

THE EXAMINATION OF THE EFFECTS OF KINETIN AND IAA ON THE CALLUS, ROOT, SHOOT FORMATION OF NICOTIANA TABACUM. Wende Hoskins, South Pemiscot High School, Steele, Missouri, 63877; Route #4, Steele, Missouri, 63877

The purpose of this project was to examine the effects of Kinetin and IAA on the callus, root, and shoot formation of Nicotiana tabacum and suggest a proper balance of these two hormones for the most rapid differentiation of roots and shoots.

I took a stem from the tobacco plant and sterilized the stem by placing it in chlorine water. The stem was broken and the cork borer was inserted into the pith. The segment was cut into individual disks. The disks were put into test tubes containing callus intiation medium. After the calluses increased in size, they were cut into sections and placed in tubes containing shoot development medium. When shoots developed, the calluses were placed in test tubes containing root intiation medium. Roots formed then the plantlets were transferred to soil. Two hormones were added to induce rapid growth in each of the three stages. The amounts used of IAA were 0.1 to 3 mg/l, and the amounts used of Kinetin were 0.1 to 1 mg/l. The control group contained 0.3 mg/l of IAA and 1 mg/l of Kinetin, the suggested balance of hormones by Murshiage.

Calluses were developed and sub-cultured by tissue culture. Proper ratio of Kinetin to IAA seems to be close to 0.2 to 2 mg/l for callus formation, 1 to 0.1 for shoot formation, and 0.1 to 3 for root formation.

It is possible to grow an entire plant from only one cell. Each cell contains the entire genetic program. Proper balance of these hormones will increase the rate of growth in the formation of plantlets from the callus stage.

THE EFFECT OF SEED SIZE ON WHEAT - A QUANTITATIVE STUDY

Ireland, Neil, Coomealla H.S., Dareton, NSW, Australia 2717;
Peaka Station, Wentworth, NSW, Australia 2648.

Wheat products are the main food of hundreds of millions of people throughout the world. It is therefore important to improve the chances of a wheat being successful.

The project set out to examine in a quantitative way, the effect of seed size on the factors that determine crop success and thus to see if the size of the seed planted affects the chance of success of the crop. This was done by measuring 1000 seeds with a micrometer and categorising them in 10 evenly spaced groups (around average). The seeds (10 from each group) were grown in cotton wool in petri dishes and watered with a mineral solution. This pattern was repeated for each of the experiments and the number of seeds germinated noted in experiment one and the average group height of the plants calculated in the other experiments. The grazing was simulated by cutting off the plants at a certain height while drought and frost were simulated by placing the seeds in a freezer and by depriving of water respectively.

The results achieved showed that the larger a wheat seed the faster its growth rate, the better its regrowth after grazing, and the stronger its drought and frost resistance. The seed size does not affect germination significantly unless the seed is very small.

#Fourth Award - General Motors ISEF

A Study of Twenty - Two Fern Species found at Camp Crozier - Río Abajo State Forest with emphasis in its Taxonomy, Ecology and Development of Life Cycle.

Guadarrama, María E. - María Cadilla High School,
Arecibo, Puerto Rico 00612
#57 Domingo Rubio St. - Arecibo, Puerto Rico 00612

The purpose of this investigation is to study the taxonomy, ecology and development of the life cycle of twenty - two fern species found in Camp Crozier - Río Abajo State Forest.

The first phase of this investigation was to establish the variety of fern species with special attention on its structural characteristics, stage of growth and distribution of habitats. The second phase was to identify if these fern species follows a definite pattern of growth and distribution on the area and determine how climatic and edaphic factors affect the species. The third phase was to investigate if thes fern species have the same length of time for the growth and development of its life cycle and the causes that could accelerate or retard their life cycle causing an increase or decrease of the species in a particular habitat.

Use of taxonomical keys, cuadrant technique, use of climatological instruments and data, study of texture, permeability, water capacity and prepairing, staining of microscope slides of fern parts were among the methods used during the investigation revealing the following: a variety of twenty - two fern species were located, identify and classified growing in small groups and in different habitats on the area; climate and soil have a direct effect upon its growth and control the length of time for the development of the life cycle of various species, especially Pteriduim aquilinum, Gleichenia bifida and Polypodium polypodiodes.

#MICROBIOLOGICAL, PHYTOPATHOLOGICAL, STATISTICAL AND CHEMICAL STUDY OF VARIOUS FUNGI SPECIES ACTING AS BIOLOGICAL CONTROL "IN VITRO" AND "IN VIVO" FOR PHYTOPHTHORA INFESTANS IN LYCOPERCICON ESCULENTUM

Roman-Irizarry, Elsa Jacqueline, Dr. Pila High School, Ponce, Puerto Rico 00731
A #7A Rep. El Valle Maguelles, Ponce, Puerto Rico 00731

The purpose of this investigation is to determine microbiologically, phytopathologically , statistically and chemically the capacity that various fungi species have to control biologically "in vitro" and "in vivo" to P.infestans, mold that caused the late blight in tomatoes and potatoes crops. Results analized statistically using the ANOVA and the New Multiple Range Test in the first phase, showed that Trichoderma viride, Aspergillus niger, Penicillium lilaceum and Penicillium citricum can control the pathogen "in vitro" , while T.viride, A.niger and P.lilaceum have the capacity to control P.infestans "in vivo". The fourth phase of this investigation is based on the separation and identification of the biocontrols components with the objective of testing "in vitro", which of thase components are inhibitor agent to P.infestans . We used Paper, Thin layer, Column and Gas chromatography in conjuction with Mass spectrometry. The results revealed that using a 100% of Acetone we can obtain in PC,TLC and CC methods 4 bands in T.viride, 3 bands in A.niger and 4 bands in P.lilaceum . The GC/MS spectrums showed that some components in the extracts of T.viride and A.niger are the same . Those components are from the Halogens family, Nitrite, Nitrile, Aromatic compounds and Saturated hydrocarbones. I'm analyzing the P.lilaceum extract and desgning a susceptibility test with the separated components too. The results of the electrophoretic methods are in process.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

*ZEA MAYS, CAN IT BE GROWN AS A PROFITABLE CASH GRAIN CROP IN SOUTHWESTERN NORTH DAKOTA?

Haberstroh, Jimmy L., Mott High School, Mott, N.D. 58646
Rural Route 1, Box 78, Mott, North Dakota 58646

The purpose of this project was to research the yield and profitability per acre of the hybrid corn varieties grown on our farm in 1984. The research was conducted on the same soil type, using the same fertility, in two different crop rotations. The two crop rotations were: #1 corn-on-corn and #2 corn-on-sunflower. The hypotheses were: (a) The #1 rotation would produce higher yields, mainly due to a better moisture supply at planting resulting from the lesser moisture requirements of the previous crop; and (b) The yields should be at least 36 bu. per acre, our ASCS county average. The test plots were adjoining to minimize temperature and rainfall discrepancies. I monitored the plots on a regular basis, checking the growth, moisture conditions, weed infestation, plant disease, insect infestation, tasseling, silking, pollen shed, and maturity. Twenty-five ears of each variety were harvested. The average ear weights were converted to ear corn bushels, then the ear corn bushels were converted to shelled corn bushels to determine the average yields. My results showed that crop rotation #1 did produce higher yields, but it was less profitable per acre, largely due to the high cost of the pre-emergence chemical required for weed control. The lowest yield per acre, even in this abnormally dry year, was 39 bu. per acre. This is 3 bu. more than our ASCS county average yield. I concluded that corn can be grown as a profitable cash grain crop in S.W. N.Dak.

*Fourth Award - General Motors ISEF

EXPLORING THE NITROGEN-POTASH RELATIONSHIP IN CORN

Laible, Philip D., Mid-County Jr.-Sr. High School,
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The purpose of my experiment is to discover what the most economical rate of nitrogen is for corn and to see if different rates of potassium would affect the results. Also, I wanted to look for differences in the stalk structure of the corn plant caused by different fertilizer rates.

I took a ten acre plot and applied different rates of nitrogen and potassium throughout the field. Everything else done to the plot was the same throughout. Each different strip was examined for yield, test weight, and moisture content. Also, two times during the year cross sections were collected from the stems of plants from each strip of fertilizer. These sections were examined under an electron microscope at both a high and low magnification, and pictures were taken.

From an average of three years of data, it is clear that a rate of nitrogen in the range of 120 to 160 lbs./A is most economical. This year because of weather a rate of fertilizer of 80 lbs. of nitrogen/A and 120 lbs. of potassium/A was most economical. I have found the ratio of N to K to be important. This year the ratio of nitrogen to potassium of 2:3 produced larger yields throughout the field. While studying the electron microscope pictures, I noticed a big difference in the sizes of the vascular bundles. The rates of fertilizers that had a 2:3 (N:K) ratio produced larger average bundle sizes. My hypothesis now is that there is a relationship between the vascular bundle size and yield.

#INTERGENERIC PROTOPLAST FUSION: SPECIES PLANTARUM NOVARUM?

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Protoplast fusion is a new area of study in the field of botanical biotechnology. Protoplasts are obtained by removing the cell walls of plant cells with enzyme solutions. Fusion between two unrelated protoplasts is then induced to obtain a hybrid cell. This research was undertaken to examine the variables involved in interspecific fusion. It was extended to include intergeneric fusions after early success was achieved with interspecific.

Cells were prepared for fusion by sterilizing donor leaf cuttings in a five percent sodium hypochlorite solution. Leaf cuttings were ground over a sieve, and cells were collected. Cell walls were removed by enzymes, and the protoplasts were separated from debris by centrifugation. Protoplasts from unrelated plants were combined on a PEG substrate for fifteen minutes to obtain fusion. The substrate was diluted, and fused protoplasts were transferred to a solid medium for growth. Chromosome analyses were performed on both plant cells and fused protoplasts.

Most fusion attempts were successful. Fused protoplasts reformed new cell walls and began the process of mitosis and cytoplasmic division. Undifferentiated cell masses were obtained from the interspecific fusion of Euphorbia platyclada and Euph. pseudocactus and from the intergeneric fusion of Philodendron "Black Cardinal"™ and Scindapsus aureus. Both cell cultures are continuing growth at the time of this writing.

"Black Cardinal" is a trademark of Bamboo Nurseries, Orlando, FLA

#First Award - General Motors ISEF

A SEARCH FOR SALT TOLERANCE IN THE UNIVERSALLY VALUABLE VEGETABLE: TOMATO.

Cheng, Tai, Manatee High School, Bradenton, Fl. 33505;
6844 14 St. West, Bradenton, Fl. 33505

This research project dealt with the salt tolerance in tomatoes. The purpose is to obtain a marketable, salt tolerant hybrid tomato. Lycopersicon esculentum, a salt sensitive, commercially valuable species, and Lycopersicon penellii,a salt tolerant (halophytic), wild genotype, were chosen to be the parents. Crosses were then made, and while the fruits were setting, two other experiments were conducted to test the degree of salt tolerance and its responses of the two parent species which were grown in different concentrations of Na Cl solutions. Data of the sugar concentration, Na+ concentration, presence of amino acids, and the rate of growth were collected and analysed to detect the extent of the salt tolerance.

Physical data was also taken and compared. The results of these experiments were used as background data when the seeds from the crosses were grown. Once the fruits ripened, the sees were separated into ten groups and grown in the different concentrations of NaCl solutions with consideration from the experiments conducted previously. The data taken from the hybrid were parallel to that of those in the last experiment.

PHOTOVOLTAIC ROOT STIMULATION: A PROCESS TO INCREASE PLANT GROWTH

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509 Highway 69 South, Camden, TN 38320

Twenty California Wonder Bell Pepper seeds were planted in separate pots to be used to test the effects of photovoltaic root stimulation on plants. Ten pots contained photovoltaic cells and the other ten did not. All conditions were monitored, and each five days measurements of plant height, length of leaves, and width of leaves were recorded. The results of this experiment showed a definite increase in the growth of the plants exposed to photovoltaic cells.

HOW DOES THE PHLOEM AND XYLEM DIFFER IN LEAVES, STEMS, AND ROOTS?

Estes, Angela R., Rifle H.S., Rifle, CO. 81650;
0510 County Road 321, Rifle, Co. 81650

The purpose of my project was to find out if there was a difference in the phloem and xylem tissues in the leaves, stems, and roots of plants.

I grew five different kinds of plants: zucchini squash, beans, peas, sunflowers, and corn. I also bought a geranium plant. The bare roots were placed in blue-dyed water for three-seven days. I cut very thin cross-sections from the leaf, stem, and root and dipped them in paraffin to preserve them. After the cross-sections were placed on a slide, I observed them under a microscope. The dicot plants had one vascular bundle in the main vein, six to eleven in the stem, and three to eleven in the root. The monocot plant had nine vascular bundles in the main vein, ninety-six in the stem, and six in the root.

I concluded that the phloem and xylem tissues differ not only in number but also in arrangement.

#ELECTROPHORETIC DETECTION OF A NEW PROTEIN IN DISEASED PLANTS

Johnson, Polly, Paducah Tilghman High School, Paducah, KY 42001
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The purpose of this research was to determine if there is a relationship between the immune response and the protein pattern of the cucumber. Cucumber plants acquired immunity to the disease anthracnose caused by Colletotrichum lagenarium after having been initially innoculated with a spore suspension of the fungus. Leaf extracts for both healthy and infected plants were prepared by homogenizing and centrifuging cut-up leaves with cold (0-2° C.) McIlvane Buffer (pH 2.8). The leaf extracts were then electrophoresed for twenty-five minutes using an agarose gel in a Beckman Paragon Electrophoresis System and were later read on a Beckman Densitometer. It was found that both healthy and infected plants produce a protein, Protein I, with and R_f of .36 and a relative concentration of 74.7 while only infected plants produced a new protein, Protein II, with and R_f of .54 and a relative concentration of 15.4. The appearance of this protein appears to be related to or responsible for the immune response in that both appear in a plant after the onset of infection.

#Third Award - American Phytopathological Society
Third Award - General Motors ISEF

*METHOD FOR CELLULAR DIVISION AND PROPAGATION WITH THE MARROW OF CAPSICUM CUBANELLE IN A LIQUID CULTURE MEDIA.

Maldonado Irma Iris - John F. Kennedy High School
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P.O. Box 93 - Santa Isabel, P.R. 00757

In this investigation there were developed three liquid culture media (A,B,C) that produced cellular division with cells from the marrow of Capsicum cubanelle. It was also developed a solid culture media that produced callus formations from these cells.

The liquid culture media were prepared by modifying the Murashigue multiplication media by the remotion of agar and auxins and the addition of citokinines in different concentrations and proportions. The solid media was developed by adding a proportion of 20 mg of NAA per 1 mg of IAA and .16 mg/L of agar to the liquid culture media. The physical factors of light, pH and temperature were controled. Two sets of each media were stablished at light and darkness.

The cell concentration was measured by using a Bausch and Lomb spectronic 70. It was discovered that the greatest cell production (89.0%) was in the liquid culture media C under conditions of darkness, pH 6.8 and 25°C.

The production of callus was 80% in light and 60% in darkness both at 25°C and a pH of 6.8.

I found that the mathematical proportion between auxins and citokinines is the cause that produce cellular division and callus formation.

Thus if I reduced the mathematical proportion of citokinines in the liquid culture media C from 1:40 mg/L to .5:20 mg/L a greater production of cellular division could be obtained. Otherwise if we increase the amount of auxins in solid culture media C from 2:.1 mg/L to 4:.2 mg/L, we can obtain a greater production of callus.

*Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

CHANGES IN DENSITY AND CHEMICAL COMPOSITION OF DECOMPOSING WOOD IN TWO TROPICAL FORESTS

Velilla, Marinelly — UPR High School,
Rio Piedras, P.R. 00931
B-18 Monforte St., Villa Andalucia, Rio Piedras, P.R. 00926

Wood mass and chemical composition of decomposing wood in palm and tabonuco forests in Puerto Rico were studied. Fourty 100 m plots were sampled in each forest type. All dead wood with diameter > 5 cm was mapped, classified in one of five decomposition stages and measured. Wood samples were analyzed for wood density, water content, and chemical composition (Ash, N, P, K, Ca). In the palm forest dead wood volume was 33.5 m/ha (11% of all wood in the forest) distributed as follows: 69.7%, 3.3%, and 27% in lying dead, stumps and standing dead respectively. Dead wood mass was 8.7 t/ha (8% of all wood mass). In the tabonuco forest dead wood volume was 76.4 m/ha (18% of all wood in the forest) distributed as follows: 86%, 10%, and 4% in lying dead, stumps, and standing dead respectively. Dead wood mass was 24.2 t/ha (11% of all wood mass). Wood density decreased linearly through decomposition but those of tabonuco forest did not. Potassium concentrations increased. Calcium concentration increased with stage of decomposition in the palm forest and decreased in the tabonuco forest. Ash and P decreased but then increased in concentration. All nutrients exhibited a net loss through the wood decomposition process. This reflects uptake by plants or loss to leaching.

COMPARISON OF THE EFFECTS OF COMMON POLLUTANTS ON MARINE PLANTS OF THE SHALLOW WATERS OF PUERTO RICO

Santana, Angel E., Dr. Pedro Perea Fajardo H.S., Mayaguez, PR 00709; Reparto Universidad Calle 4 L-22, San Germán, PR 00753.

Thalassia Testudinum König or turtle grass is a marine angiosperm, that with various associated species, form a characteristic assamblage, known as turtle grass meadows, on sandy and muddy bottoms. This plant is the most dominant of the marine grasses of Puerto Rico. Ulva lactuca is a green alga which is quite abundant in this habitat. This investigation is an attempt to consider some aspects of the ecology of these plants on island waters emphasizing the effects of pollution on these plants and postulating the use of the large biomass, made up mainly of these two plants, that the sea puts ashore daily, as a possible source of energy.

Nine stations were selected along the southwestern coast of the island. The environmental parameters affecting these plants were determined. A chemical analysis of the plants in each station was carried out to determine water, organic matter and mineral content. The same was done for the substrate. The growth of Thalassia in each station was measured as well as percentage of browsing.

To determine the effect of contaminants such as urea, DDT, Gasoil, Risn and Vel. on the plants, the organisms were subjected to concentrations of 1%, 1%, .01%, .001% and fresh sea water as a control. The effect of the pollutants was determined by checking the liberation of O_2 bubbles as the plants were allowed to carry on photosynthesis.

Photosynthetic pigments, chemical composition and internal anatomy of plants were also analyzed for the plants exposed to the different concentrations to determine these effect.

A determination of how many tons of biomass per acre are produced at each station was carried out. Amount of biomass thrown by the sea on one station was calculated. Amount of methane gas produced by this biomass through fermentation was calculated and a good yield was obtained.

A COMPARISON OF THE EFFECTS OF MICROWAVES ON VARIOUS TYPES OF SEEDS

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3110 Lazy Lake Dr., Harlingen, TX 78550

The purpose of the experiement was to determine the effects, differences and similarities of microwave exposure on the germination rate of seven types of seeds.

Each sample was exposed to microwaves for varying periods of time (0 - 90 sec.). The samples were examined every two days over a ten day period and observations made based on number germinated, odor and appearance.

The results indicated that most of the seed groups responded to microwave exposure in a similar manner. In general, as microwave exposure increases, the germination rate decreases. Two groups of seeds were more resistant to increased exposure.

Comparisons were made to determine if color, hardness of seed coating, size or moisture content were factors in the response of the seed groups to microwave exposure. Two factors, hardness of seed coating and moisture content, did correlate with the seeds' resistance to microwaves. The seed groups with the harder coating and lower moisture content continued to germinate at higher levels of microwave exposure.

Very low amounts of microwave exposure (5 - 10 sec.) resulted in a more rapid rate of germination in the seed groups.

A LONG TERM STUDY OF THE EFFECTS OF ELECTROMAGNETIC RADIATION ON GLYCINE MAX WHEN THE SEEDS ARE TREATED PRIOR TO PLANTING - PHASE III

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In Phases I and II, it was determined that of five different kinds of electromagnetic radiation only infrared radiation had any significant overall effect on Glycine Max (soybeans) when the seeds were treated prior to planting. Consequently, the purpose of this study, Phase III, was to determine specifically the effect of infrared radiation on Glycine Max.

This study began by dividing the seeds into nine groups (a control and eight treatment groups) and exposing two of the treatment groups for the same time period but with the hilum of one group toward the source and the hilum of the other group away from the source. The lengths of treatments were 5, 10, 20, and 40 minutes. The germination and vegetative growth of each plant was monitored; water content, pigment, catalase, glucose, and sucrose determinations were performed on a regular basis. The cytological and morphological structure of plants from each group was observed. The production of each plant was determined; chemical analyses were performed on the fruit from each group.

Statistical analyses were used on the data. The results implied that shorter exposures to infrared radiation stimulated vegetative growth but inhibited production while longer time exposures inhibited germination and vegetative growth but stimulated production. This increase in production could possibly be attributed to the larger phloem region which was observed in the longer exposure groups. Also, seed position during treatment significantly effected the germination, vegetative growth, and production. The infrared radiation could have effected the photosensitive protein pigment phytochrome; however, the exact effect of the infrared radiation on the phytochrome will require further study and experimentation.

#First Award - Eastman Kodak Company
First Award - United States Army
Second Award - General Motors ISEF

GREEN IS BEAUTIFUL

Pennington, Barry D., St. Charles H.S., St. Charles, Mo. 63301
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Due to the predictions of a food shortage, I fed chickens Chlorella pyrenoidosa, for a period of four months. The results were astonishing! The chickens in group C being fed strickly algae gave more eggs than group B, being fed a mix of chicken feed and algae, and the controls, group A, being fed straight chicken feed. Group C eggs seemed to be richer and more stable than the other two group eggs.

When I handled the algae, my hands were dyed with a greenish tint which gave me the idea of cloth dying. I worked with cotton mixes, dying them with a different algae dye solution of varying strenghts.

To be conclusive about the dying properties of algae the six inch squares were cut in two. One piece was kept for the color comparison, the others were washed fifty times. (Remember, the pieces were not subjected to wear.) After fifty washings, the pieces were about the same color as the ones that had not been washed.

While doing the wash I came up with another idea, to use algae as fuel. After I dried the algae I lit a handfull with a match, it went up like a cluster of lent. The heat produced was very hot and intense, yet it only lasted for twenty-one seconds. I tested this possiblity for six weeks and found my results inconclusive to conclude anything except Chlorella burns and the ashes are a great fertilizer.

In conclusion, Chlorella pyrenoidosa can be used for many things, including those not yet discovered.

EFFECTS OF EXTRACTS OF LANTANA CAMARA ON THE GERMINATION OF SEEDS

Torres, Vicente, Lola E. de Tió High School, San Germán, PR 00753; Box 456, San Germán, PR 00753).

Lantana camara or milk weed is a common an undesirable weed found in Puerto Rico with a strong desagreeable odor. It is known for its ability to suppress other weeds. Release of toxic metabolites by plants, known as allelopathy, is one weed suppression mechanism. This investigation is an attempt to determine the effect of L. camara on the germination of the seeds of Phaseolus vulgaris, Lactuca sativa, Brassica oleracea and lycopersicum esculentum.

Extracts were prepared at a 5% concentration and applied to the different seeds in Petri plates. Twenty five seeds were used per plate. They were kept moist with the extract except for one plate which was used as a control. Rate of germination for all four seeds was compared against control. Growth of epicotyl was measured for a member of days and observed for anomalies. Results indicate the extract affected germination and growth af all seedlings.

An attempt was made to determine if the plant contains volatile substances which inhibit germination of seeds. Covered seeds allowed to germinate in the presence of leaves of L. camara showed inhibition of germination.

P. vulgaris seeds were exposed to different concentrations of extract (5%, 25%, 50%, 75%). Effects varied with concentration.

A study of L. camara in nature was carried out. The diameter of the area under the plant where no weeds were found growing was studied for 25 plants in each of four stations. Results showed diameter is proportional to size and age of plant but no plants seem to be found growing in nature under L. camara

Percentage of water, organic matter and mineral content were determined for the plant.

ALLELOPATHY: CAN SEEDS INHIBIT GERMINATION OF OTHER SEEDS?

Haslam, Jeffery J., Lawrence High School, Lawrence, Ks 66046
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The plant residues of black walnut, apple, and decaying sorghum are known to inhibit the growth of other plants. The purpose of this research was to test whether seeds can inhibit the germination of other seeds.

Procedure: (1) Water extracts of seeds (radish, lettuce, mustard, sorghum, and hulls of black walnuts) were tested for inhibition of germination. (2) Seeds were also germinated on an agar medium to see if inhibitory substances were transported into the medium surrounding the seeds. The medium was then checked for inhibitory action on other seeds at varying distances from the germinating seeds.

Water extracts of mustard, sorghum, and black walnut had an inhibitory effect on the germination of some seeds. Of interest was the observation that the water extracts of lettuce seeds delayed the germination of lettuce seeds longer than the extracts of other seeds. Lettuce seeds may have a natural thinning mechanism.

The extent of inhibition caused by seeds grown on the agar medium was not as great as the water extract results. It may be that the inhibitory substances are not transported to any great distance from the seeds under these conditions.

The substances extracted from seeds which have an inhibitory effect on germination of other seeds have possible applications as the basis for natural herbicides.

"THE USE OF THE INSECT DINODERUS MINUTUS FOR THE PROTECTION OF THE TREES: PERSEA AMERICANA, MANGIFERA INDICA, SPONDIAS MOMBIN, TAMARINDUS INDICA, MAMMEA AMERICANA AND DELONIX REGIA"

Sánchez, Antonio., Josefa Pastrana H.S., Aguas Buenas, PR 00607; Res. Villa Mons. Edif. 4 apt. 58, Aguas Buenas, PR 00607

The Dinoderus minutus natural habitat is the Bambusa vulgaris, where it helps in the conservation of this tree by destroying the insects around it. The insects only food consists on the fungus Hydropsia numpa, bamboo residues and other insects. I wanted to test if the Dinoderus minutus could adapt to other trees so it could eliminate plagues in them. In the first phase I used 24 Dinoderus minutus and 120 in the second phase; all were placed in each tree selected for the experiment. I used the following species of trees: Persea americana, Mangifera indica, Spondias mombin, Tamarindus indica, Mammea americana and Dolonix regia, a total of 10 trees. In each one of them I used two trees with plagues and one free of plagues, except the Delonix regia where I used three with plagues. Blucesis auritis, Percuri sthela, Clastidium curitacic, Cryptotermes brevis and Nasusitermis costalis were the studied plagues. In each tree I constructed a sort of tunnels in the bark where the Dinoderus minutus was placed to verify its growth, adaptation and elimination of the plagues of the affected trees. The results obtained were: The Dinoderus minutus adapted to the habitat change, eliminated plagues and caused no secondary effects. I can conclude that the Dinoderus minutus was used as a biologic control for the conservation of forestal resources. My future projection: Iá looking forward to continue studies in dry wood to verify its use.

IAA and UVR

Morgheim, Jeffrey S., Service H.S., Anchorage, AK 99507
8700 Solar Dr., Anchorage, AK 99507

The object of this experiment was to determine if strong amounts of ultra-violet radiation effect the elongation properties of indoleacetic acid in plant tissue. To fulfill this objective, oat seedlings were germinated. When they had developed stems, they had their coleoptiles removed. Another cut was made farther down the stem to make 10 mm sections. The sections were placed equally into two solutions, both containing sucrose, water, and IAA, with one of the solutions containing IAA that had been treated to 24 hours of UV radiation. After the sections had been in the solutions for 24 hours, they were measured. I repeated this procedure four times with 10 control and 10 experimental seedlings at a time. After 24 hours, 100% of all the control sections had shown elongation, in comparison to 27% of the experimental sections. The control sections had also shown an average of 1.69 mm elongation, as compared to 0.34 mm of elongation of the experimental sections. Since the IAA in both solutions elongated cells in many sections of both groups, and the sections in the solution containing the IAA treated with the ultra-violet light radiation had elongated less in numbers and in elongation, I conclude that strong amounts of ultra-violet radiation reduce the elongation properties of IAA. I plan to expand this project by studying different wavelengths of UV radiation, and by studying individual cells under the microscope that the IAA is given to.

#FURTHER INVESTIGATIONS INTO THE ALLELOPATHIC ACTIVITIES OF BUCKHORN PLANTAIN

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Problem: Buckhorn Plantain became dominant in a lawn. Research done in 1981-83 suggested allelopathic properties of the dried Buckhorn weed. This year's research asked four questions: 1.Is there a difference in the actions of the inhibitor in the fresh June and September Buckhorn plants? 2.Does fresh September Buckhorn leachate affect bluegrass biomass? 3.If Buckhorn is mixed in soil, is the germination and biomass of later planted bluegrass affected? 4.Is there a difference in the number of compounds present in various Buckhorn solutions?
Hypotheses: I hypothesized the answer "yes" to each of the above questions.
Methods: Fresh June and September Buckhorn solutions were prepared. Leachates from living Buckhorn plants were collected, Buckhorn was mixed in soil, and all were tested on bluegrass. Gas chromatography was run.
Results and Conclusions: 1.Fresh September Buckhorn root, leaf, and whole plant solutions were more inhibitory to bluegrass biomasses than were the fresh June solutions. 2.Fresh September Buckhorn leachate inhibited bluegrass biomass by 56%. This may be the most representative of living Plantain's effects on the natural environment grasses. 3. After Buckhorn plants were allowed to stay in soil for 71 days, bluegrass germination was slightly inhibited, and biomass was inhibited by 43%. This may simulate most closely the effects of "wintered" Plantain on the natural environment's grasses. 4.Impure distilled water present in tested Buckhorn solutions disrupted gas chromatography tests, but solutions with different distilled water will be tested in the future.
Applications: Possible use as natural herbicide.

#Second Award - General Motors ISEF

#EFFECT OF CHITIN SYNTHASE INHIBITING INSECTICIDES ON THE GERMINATION OF APPLE POLLEN

Bauer, Julie A., Barry H.S., Barry, IL 62312,
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The purpose of this research was to determine if chitin synthase inhibiting substances effect the germination of apple pollen. Chitin is a polysaccharide component of the cell walls of filamentous fungi and the exoskeleton of arthropods. An enzyme, chitin synthase is involved in chitin production in these organisms. Recently, several substances have been found to inhibit chitin synthase enzyme forming the basis for a new group of fungicidal/insecticidal agents. Since pollen lacks chitin, it was hypothesized that the chitin synthase inhibitors would not effect pollen germination. Several representative fungicidal/insecticidal agents were tested for effects on apple pollen germination at recommended and chitinase inhibitor equivalent rates. Chitin synthases inhibitors, Polyoxin D and Dimilin, were tested for effects on the germination of apple pollen at 10^{-4} 10^{-6}M, and 10^{-8}M. Results were recorded in percent germination of controls. The representative classes of fungicidal/insecticidal agents were found to significantly effect pollen germination. Polyoxin D and Dimilin were found not to have significant effects on apple pollen germination. Research indicates that Polyoxin D may possible be useful as a fungicidal/insecticidal agent during bloom season.

#Fourth Award - General Motors ISEF

#CARBON AND PHOSPHORUS: THEIR ROLE IN THE PREVENTION OF SPIKELET ABORTION.

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A two year study was undertaken to determine the effects of carbon and phosphorus on floral initiation in corn. Floral initiation is the growth stage where the plant transists from the vegetative stage to the reproductive stage. It is during this time that many of the spikelets, that will later mature into fruit, will abort and die. Often the cause of this abortion is a toxicity in the plant. A greenhouse and a field experiments were carried out to determine if carbon (in the form of activated charcoal) and poly-phosphate (in the form of phosphoric acid) will prevent spikelet abortion by absorbing toxicities, increasing mineral uptake, promoting growth, and increasing yield. It was concluded that carbon in the form of activated charcoal favorably affected plant growth, mineral uptake, and yield. It also prevented some toxicity in the plants. It was also found that poly-phosphate in the form of activated charcoal favorably affected plant growth, mineral uptake and yield.

#Second Award - United States Air Force

IDENTIFICATION OF PLANT IMMUNITY MECHANISM

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In phase 1 of the experiment, cucumber plants were inoculated with a known pathogen of cucumbers - Colletotrichum lagenarium. This caused lesions to appear on the first true leaves. After a period of growth the plants were inoculated on the second true leaf of the plant. There were very few lesions this time which seemed to indicate an immunity to the disease had been produced.

In phase 2 of the experiment, disease-infected plants were grown and their growth was measured and compared to healthy plants. The diseased plants grew better and were healthier than the controls. This evidence seems to indicate a type of mutalistic relationship now existed between the infected plants and the disease organism.

In phase 3, the mechanism that produced the immunity was studied. Evidence indicated a change would be found in the protein. Electrophoresis was used to separate the protein in the control plants and the diseased plants. There was a distinct difference in the bands, which gave evidence of the immunity mechanism.

CAN ANTIMICROBIAL SUBSTANCES BE FOUND IN SELECTED VEGETABLE SEEDS?

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This investigation determined if selective vegetable seeds possess bacteria inhibiting capabilities. The following procedure was used. Seeds were ground into a powder and mixed with distilled water to form a paste. This paste was hand pressed through cheese cloth and the filtrate served as the seed extract. Filter paper discs soaked in the extracts were introduced into selective non-pathogenic bacteria cultures. The cultures were then incubated for 72 hours. During this incubation period, the cultures were examined at 24, 48, and 72 hour intervals to determine whether or not bacteria growth was inhibited. The diameters of the bacteria-free areas around the discs were measured and recorded. If these seed extracts prove to retard bacteria growth, they may some day offer a wide range of new medicines produced from natural and not artifical sources.

OSMOSIS AS A FACTOR IN PHOTOTROPISM

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Phototropism is the bending of plants toward a unilateral source of light. When only one side of a plant is exposed to light, the light travelling internally on the shaded side (facing away from the light source: Side A) is three times greater than the light channeled internally on the illuminated side (side B). More light on Side A could result in a higher rate of photosynthesis, a greater production of carbohydrates, increase in intracellular osmotic pressure, higher water content, and higher turgor pressure. The swelling of only the cells of Side A and not of Side B could cause the bending of the plant toward the light. Three experiments were performed to test this hypothesis. In experiment One, a piece of foil was inserted vertically into a slit in the apex of the oat coleoptile to block the incoming light from being reflected to Side A by the apical cells and, in turn, to prevent an increase of the rate of photosynthesis in Side A. The resultant effect was observed. In Experiment Two, coleoptiles previously subjected to unilateral light were placed in a pH4 solution to see if the cells of Side B, being in a hypotonic solution, would be swollen already. In Experiment Three, the two sides were tested for carbohydrate concentrations to see if the rate of photosynthesis is greater in Side A than in Side B. The results of Experiment One showed that the foil does retard phototropism. The specimens of Experiment Two did not straighten. In Experiment Three, concentrations from Side A were slightly higher. The results from this experiment show that osmosis does not play a major role in phototropism.

THE EFFECT OF JUNIPER EXTRACTS ON SEED GERMINATION

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Often no undergrowth is found under Juniper trees in Utah. This lack of undergrowth can be partially explained by Junipers strong competition for water but it was postulated that Juniper produces chemicals that inhibit growth of other plants. To test this hypothesis extracts were taken from roots, green leaves, dead leaves and the soil around a Juniper plant and tested for their effects on the germination of radish and oat seeds. It was found that extracts from green leaves and roots had an obvious effect on the germination of radish seeds. The effect was not as obvious with the germination of oats but there was a slight reduction.

I postulated that Juniper oil is the active ingredient in the inhibition of seed germination. To test this Juniper oil was extracted by simple distillation of macerated Juniper foliage. Juniper oil was applied to seeds at concentrations of 1:100, 1:1,000, 1:10,000, 1:100,000 and 1:1,000,000. All dilutions of Juniper oil inhibited oat seed germination. Germination was reduced to at least 25% at all dilution levels. Radish seeds were reduced by about 20% at the dilution of 1:100,000. Even though other factors may be involved Juniper oil apparently inhibits germination of seeds.

THE GA PROBLEM

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When the fungus Gibberella fujikuori attacks a plant, it secretes gibberellic acid (GA), which causes the stem of the plant to grow so long that the plant falls over. The plant cannot support itself because of stem growth without corresponding root development. This is the GA problem.

I attempted to grow GA-treated plants which could support themselves. Since the Alaskan pea plant has a suboptimal concentration of the root growth hormone indolebutyric acid (IBA), I sprayed GA-treated pea plants with IBA in order to find out if increased IBA could stimulate further root growth and thus support the plant.

Four flats of Alaskan pea seeds were treated in the following manner: control, 10ppm IBA, 5000ppm GA, 5000ppm GA and 10ppm IBA. Eighteen days after treatment, the mean stem height and mean root length of each flat were calculated. Then these means were statistically compared in order to determine the significance of the data.

The F Test of the analysis of variance shows that in the Alaskan pea plant, 5000ppm GA stimulates significant ($p<.05$) mean stem growth, 10ppm IBA promotes significant ($p<.05$) mean root growth, and there is no interaction between GA and IBA. Thus, my experiment demonstrates that IBA, by inducing increased root development, is able to support a GA-treated pea plant.

PLANT REGENERATION FROM MERISTEM, STALK, LEAF, AND ROOT EXPLANTS

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Tissue culturing and growth mediums are relatively new in the Botany field. A growth medium is a water-based, nutrient rich solution which supplies an explant with everything it needs in order to sustain life. Although scientists are capable of regenerating new plantlets in a growth medium, a careful study of what parts of the plant regenerated has not been carried out. And most importantly, why is it that only certain parts of the plants regenerate? This is the problem addressed in my experiments.

After having made the growth medium, sterilization of all materials was imperative, for bacteria can grow in the medium as well. All sterilization took place in an autoclave. After the medium, one-hundred small vials, and three beakers of water had been sterilized, work continued in a sterile hood. The medium was poured into the vials there, and six explants were cut of meristem, stalk, leaf, and root tissues from four different plants. Because bacteria is located on a plant, the explants had to go through a bleaching process. All explants were then placed in the vials, and the vials were capped.

After having observed these explants, it has been recorded that only explants containing parenchyma cells have regenerated. Therefore, it can be concluded that these parenchyma cells are the cause of regeneration. Further studies will be done on plants of related species.

ISOLATION AND IDENTIFICATION OF BIOSILICA PARTICLES--SPECIFICALLY PHYTOLITHS--FOUND IN SOIL SAMPLES TAKEN FROM BLUE BAYOU ARCHAEOLOGICAL SITE, CATALOG NO. 41VT94

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HYPOTHESIS: Phytoliths* extracted from Blue Bayou archaeological soil samples, when compared with phytoliths extracted from modern plants, will indicate native vegetation at time of burial.

PROCEDURE: To extract phytoliths from the plant samples, the organic matter was digested and destroyed in a heated HNO_3 + $NaClO_3$ solution followed by several H_2O rinses. Silica residue remained. A similar digestion technique was applied to the archaeological samples, which were centrifuged in $ZnBr_2$ to separate the silica particles from the soil. A drop of each residue was placed on a glass slide with a drop of clear oil and sealed with Elmer's glue. This mounting technique allowed the samples to remain in a liquid medium so that a gentle tap caused the 3-dimensional particles to tumble so as to be viewed from all sides. The slides were photographed through the 400X microscope with a Cannon AE1 SLR camera mounted on a Soligor T-Mount and a Kalt adaptor. Film: Kodak 400 ASA, exposure time 15-20 seconds.

RESULTS: Phytoliths from modern vegetation were isolated and identified in anaqua, hackberry, and native pecan. Soil from Burials No. 19 and No.24 was processed, mounted, and photographed. By comparison two phytoliths were identified.

CONCLUSION: The isolation and identification by comparison of the archaic phytholiths have proved the hypothesis valid.

*Indestructible silica particles found in plant tissue. The shapes are characteristic of their respective plants.

#First Award - Sigma Xi, the Scientific Research Society
Third Award - General Motors ISEF

INDUCEMENT OF POLLEN GERMINATION

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Studies using various nutrients, an antibiotic, and storage temperatures versus time were performed on pollen from different species of plants, in vitro. The effects of various concentrations of sucrose, boron and calcium were tested on the germination of pollen taken from lily, freesia, tulip, gladiolus and Christmas cactus flowers. Different concentrations of chlorotetracycline were tested on lily pollen germination. Pollen from lilies was harvested and stored at the following temperatures for a total of fifteen days: 0,5,25, and 15-38 degrees Centigrade. Lily pollen produced the highest germination rate of the five species tested. Lily pollen germinated best with high concentrations of sucrose, boron and calcium. Various concentrations of chlorotetracycline produced long and irregular tubes and at some concentrations, prevented germination. Storage at low temperatures for up to fifteen days produced the best germination of lily pollen.

#USING ELECTRICITY TO CONTROL THE DIRECTION OF ROOT GROWTH IN SPACE

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The purpose of this investigation was to test the hypothesis that electricity could be used to solve the problem of regulating the curvature of roots in the absence of gravity encountered during space flights. Seeds of corn, Zea Mays, and soybeans, Glycine max., were sprouted and suspended vertically between copper wires in vials of water. DC voltages from 6-36, in increments of 3 were applied to the wires in different trials. The roots curved toward the positive wire within 10 minutes regardless of the voltage. Generally, the roots responded faster to the higher voltages. 0.1% concentrations of IAA and lanolin and 10% concentrations of calcium compounds and lanolin were applied to one side of the roots suspended vertically in vials of water and the amount, region and speed of curvature was compared to the curvature of the electrically stimulated roots. The amount, region and speed of curvature of the IAA and calcium roots was similar to that obtained with the lower voltages. Low voltage DC electricity can control the curvature of roots and should definitly be considered as a way to control the direction of root growth in space.

#First Award - United States Air Force
Second Award - American Astronautical Society
Second Award - National Aeronautics and Space Administration
Second Award - General Motors ISEF

THE DETERMINATION OF CULTURE CONDITIONS OF VIABLE PROTOPLASTS

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This research investigated factors involved in isolation of protoplasts from carrot and tabacco suspension culture cells, leaf mesophyll cells, and callus tissue cells, in an attempt to determine the most efficient source of viable protoplasts. Concentrations of wall-digesting enzymes, temperature, incubation period and pH of enzyme solutions were variables investigated. Although protoplasts could be segregated from suspension cultures and leaf mesophyll cells, the sources were undesirable because the necessity of maintaining and subculturing suspension cells and because of difficulty in sustaining sterile conditions when using leaf mesophyll. Additional problems resulted when variables had to be readjusted to compensate for greater resistence to cell wall degradation as age of cells increased. It was hypothesized that cells from callus tissues could be maintained much more easily under sterile conditions and that these cells could be selected for age uniformity, thus producing a more efficient source of protoplasts.

It was found that protoplasts could be produced directly from callus tissues growing near the surface of the agar. Cellulose at a concentration of .5% and mannitol, an osmoticum, at .7M proved most efficient at digesting callus cell walls. No observable difference was detected between enzymes desalted through a sephadex-G50 column and enzymes used without desalting. Callus tissue had the added advantage of being younger and more susceptible to cell wall deterioration. The incubation temperature of the enzyme solution was maintained at 33°C, but the use of younger callus cells allowed reduction of incubation time, thus reducing problems with osmotic pressure and increasing the probability of sustaining viable protoplasts.

#THE EFFECTS OF DIFFERENT RATES OF APPLIED N ON GRAIN YIELD, PERCENT GRAIN PROTEIN, NO3 REMAINING IN THE ROOT ZONE FOR SPRINKLER-IRRIGATED CORN (ZEA MAYS L.) AND GROUNDWATER CONTAMINATION

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The purpose of my project was to determine how different rates of Anhydrous Ammonia (N) applied to the soil affects the grain yield, percent grain protein and NO3-N remaining in the soil for irrigated corn. The purpose of the groundwater study was to determine if any extensive areas of Nitrate-Nitrogen contamination were present in rural domestic water supplies in the four surrounding counties which are Fillmore, Hamilton, Seward, and York.

There was a total of nine plots selected on our farm, three to which 230, 330, and 430 pounds of Anhydrous Ammonia was applied to the soil. Soil profiles six feet deep were taken in October and the samples were broken down to foot increments. NO3-N content of soil, yield,percent protein and kjd-N levels of the corn grain were tested at the end of the crop year. For the water quality tests, a total of 262 wells were tested by taking water samples in June and again in September. The tests were conducted over a five-year period using a Spectrophonometer which utilizes colorimetric analysis to determine Nitrate-Nitrogen level.

It was concluded that the larger quantities of N applied to the soil were not utilized to increase yield or the percent protein of the corn. It is also evident that there is a definite excess of NO3-N remaining in the 330 and 430 pound plots. It can also be concluded that there was a definite increase in Nitrate-Nitrogen levels in the water at some areas. However, most of the levels under 10.0 ppm in the past are remaining within that range.

Statistical analysis was conducted and supports experimental conclusions.

#First Award - Bureau of Reclamation/U.S. Department of the Interior
First Award - General Motors ISEF

#LIMAX MAXIMUS MUCUS: ITS EFFECT ON PLANT GROWTH AND ROOT DEVELOPMENT

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4309 Bissonet Drive, Metairie, La. 70003

The purpose of this project is to show how Limax maximus mucus affects plant growth and root development as compared to three commercially available plant fertilizers. Seedlings of six species of plants were placed in mucus, in three different brands of fertilizers, and in distilled water. After twenty days, the following results were recorded for the five treatments using six replications.

Plants in Limax maximus mucus grew to an average height of 15.13 cm. Plants in fertilizers reached average heights of 10.2 cm. for Brand "A," 10.49 cm. for Brand "B," and 10.05 cm. for Brand "C." Water-grown plants, used as a control, reached an average height of 8.51 cm. The radicle lengths were measured, and the following results were recorded: mucus - 13.23 cm., Brand "A" - 9.94 cm., Brand "B"- 10.16 cm., Brand "C" - 9.78 cm., and water - 5.93 cm.

The results of this experiment prove that Limax maximus mucus is an excellent plant fertilizer that works 48.8 per cent better than the commercially available fertilizers now in use.

#Fourth Award - General Motors ISEF

THE ALLELOPATHIC ASPECTS OF MELILOTUS ALBA THROUGH COUMARIN

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The white sweet clover plant is one of the many plants currently found in the world that is believed to possess allelopathic capabilities, the ability to cause harmful effects on other plants through the use of chemicals. Clover apparently is a representative since experiments have shown that clover produces sharp reduction in growth and germination of competitive seeds. Through extraction, with saturated sodium sulfate solution and steam distillation, and thin layer chromatography one compound was found to be present in the clover plant and quite abundant in the soil surrounding the plants. This compound, coumarin, is apparently produced by the clover plant and released in substantial amounts into the soil through the roots since germination tests have determined that a dense field of clover may contain a concentration of coumarin nearing 10 g/m^2, resulting in an 84% reduction. The ability of coumarin alone to inhibit germination of seeds such as dandelion, tall fescue grass, corn, and white sweet clover, itself, was tested in petri dishes as well as in soil conditions at concentration from 10 g to .1 ug/m^2. The results showed that coumarin generates a pattern of high and low peaks as its concentration decreases. The effect of coumarin on growth also showed a connection to the growth reduction by white sweet clover. Since experiments have shown that coumarin tends to decompose in soil a derivative, 4-hydroxycoumarin, was synthesized and its ability to innibit germination was tested, finding slight promotion to no effect. The majority, if not all, of the allelopathic abilities of white sweet clover are caused by the chemical coumarin which apparently inhibits enzymes necessary early in germination of the competitive seeds. The use of white sweet clover to solve agricultural weed problems may be an important advantage of this plant.

#First Award - American Society of Agronomy
Third Award - General Motors ISEF

THE EFFECT OF SURFACTANTS ON PLANTS

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St. Thomas, MO 65076

In the area in which I live, there is much concern about soil condition. Hard rains compact the ground surface. The compacted surface does not allow proper water penetration. Lack of availability of water to the roots of plants results in lack of growth and as a result has direct economic effect on the individual farmer and the farming community. Surfactants have been proposed as counteracting compaction. Would then surfactants have a positive effect on plant growth? Twenty-five bean seeds (Phaseolus vulgaris) were planted in each of two (2) potting trays filled with clay loam, pH 5.7. Twenty-five corn seeds (Zea mays) were planted in each of two (2) additional potting trays filled with clay loam, pH 5.7. One tray of the beans and one tray of the corn were watered with 250 ml of tap water, pH 7.3, when they were planted and with the same amount every other day for a period of six (6) weeks. The other trays of beans and corn were watered with a solution of 250 ml of tap water and 10 ml of Basic H, pH 7.6, when they were planted and every other day for a period of six (6) weeks and the growth of both groups was recorded. At the and of six (6) weeks, the average height increase for the experimental groups as opposed to the control groups (tap water) was, for corn, 17%, for beans, 67%. Surfactants are shown to have a positive effect on plant growth.

#First Award - American Medical Association

#POPULATION DIFFERENTIATION IN MOUNTAIN MAHOGANY, CERCOCARPUS MONTANUS RAF.

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3039 South Depew St., Denver, CO 80227

Cercocarpus montanus Raf. seed were collected from four populations in New Mexico, Colorado, and Wyoming during 1983 and 1984. The primary purpose was to determine if the populations have differentiated with respect to germination requirements and to relate the responses to the modern theory of evolution. Germination tests were conducted in the laboratory. Factors considered were temperature, moisture stress, prechilling, light, and after-ripening. Seed from all four populations exhibited innate dormancy the intensity of which was removed by prechilling. Seed from populations in Colorado (8,200') and Wyoming required significantly greater amounts of prechilling than those from New Mexico and Colorado (5,650'). This indicates that populations from a higher elevation and latitude have different prechilling requirements than those from a lower elevation and latitude. Germination responses of all populations showed significantly greater germination values when given night-day temperatures of 10-25, 15-20, and 15-25 C than those given warmer night-day temperatures. Seed from populations in warmer and drier habitats showed significantly greater germination values under moisture stress than those from cooler and wetter habitats. Germination patterns and responses of Cercocarpus montanus Raf. populations were similar even though gene flow most likely does not occur. Some responses were different because of different selective forces in their respective habitats. Natural selection is therefore both the primary cohesive and disruptive force in the adaptation of this species along its latitudinal and altitudinal distribution. This conforms with the modern theory of evolution.

#First Award - United States Navy/Office of Naval Research
Second Award - United States Army

#DO SORGHUM PLANTS COMMUNICATE AND WILL THEIR COMMUNICATION RATE INCREASE WITH AGE?

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1934 Witler St., Philadelphia, PA 19115

Problem: Do Sorghum plants communicate and will their communication rate increase with age? Purpose: In a recent experiment performed by Jack Schultz and Ian Baldwin, evidence of plant communication was shown in sugar maples and oaks. This research interested me very much and prompted me to do my research, which, to my knowledge, has never been done before. Hypothesis: If I damage one of the four groups of sorghum plants growing in an enclosed tank and analyze the leaves from the other 3 groups of plants after 48 hours, I will then be able to determine whether sorghum communicates. If I repeat this procedure every 2 weeks I will then be able to determine if sorghum's communicative rate increases with age.
Procedure: Damaged plants in experiment tank every 2 weeks and analyze for tannin and phenolic content by using Visual Estimation Test and Spectrophotometric test. Results: After 2 weeks, the experiment samples showed a higher tannin and phenolic content than the control sample. Conclusion: Thus far, my data suggest that sorghum plants communicate. I am presently in the process of determining whether sorghum's communication rate increases with age.

#Fourth Award - General Motors ISEF

#USING TISSUE CULTURE TO FACILITATE GENE TRANSFER IN BLACKBERRIES

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Native blackberries have been popular in the Gulf South for generations. The southern dewberry has been the predominant kind available because they are resistant to disease and adapted to sandy soils. Dewberries do not produce high yeilds, however, and are not located in convenient places free from pests such as snakes and chiggers. Present cultivated blackberries have undesirable qualities such as large seed and susceptibility to diseases. Therefore, desirable genes need to be transferred from wild species into cultivated blackberries in order to produce good home grown or local fresh market fruit.

Crosses between wild blackberry species and cultivated blackberries are usually unfruitful because the cultivated blackberries have twice as many chromosomes as the wild ones. The objective of this research project is to double the number of chromosome in the wild species so that hybrids will be fertile and desirable genes can be transferred into cultivated blackberries.

Shoot tips from Flordagrande, Rubus rusticanus, R. trivialis, and R. allegheniensis, were treated with three concentrations of colchicine in solution and grown in tissue culture to produce cells with doubled chromosome number. Plants regenerated from these cells should produce fertile hybrids when crossed with cultivated blackberries.

R. rusticanus produced 44 plants and R. trivialis two plants large enough to transplant. No plants were obtained from R. allegheniensis or Flordagrande. The Colchicine treatment time or the growing medium may need to be adjusted to get desired results with some species. The 0.08% Colchicine dosage is too high. Tissue culture can be used to facilitate doubling the chromosome number in blackberry plants.

#Third Award - General Motors ISEF

A COMPARISON OF OXYGEN PRODUCTION IN ACID RAIN SOLUTIONS IN THREE AQUATIC PLANTS

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A continual study was conducted to compare amounts of oxygen production by three representative aquatic plants when subjected to acid rain solutions. Ceratophyllum was researched in 1983, elodea in 1984, and myriophyllum in 1985. Each of these types of aquatic plants were placed in varying concentrations of acetic, hydrochloric, sulfuric and nitric acids. Concentrations ranged from 0.1N to 0.0001N in which pH values were utilized. All samples were compared to control standards of neutral solution in representative plants at pH 7.00. Equal amounts of plant species and solutions were employed in all experiments. Color change was noted and recorded each day during the study. Dissolved oxygen was tabulated every six days using an approved and calibrated dissolved oxygen meter. (Chemtrix Model 3000). Studies indicated negative color changes from the first day of study until the end. Higher concentrations revealed extreme color changes while lower concentrations showed integrated color changes depending on strength of the acid solution. In all studies, decreased amounts of oxygen were produced. The higher concentration of acid rain solutions produced the least amount of oxygen to the aquatic environment. Results indicated that acid rain, in varying degrees of concentration, positively effect oxygen production and chlorophyll production, thus affecting the environment of aquatic organisms by decreasing needed oxygen supplies and destroying the photosynthetic process within aquatic plants.

#THE ACCUMULATION OF Cd AND Pb IN SLUDGE-FERTILIZED RADISHES

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Purpose: To determine if Cadmium and Lead accumulate in the root tip to sludge-fertilized radishes; if the amount of accumulation is toxic or non-toxic; and to determine if sludge can be used safely as a fertilizer for radishes.

Hypothesis: It is expected that the metals will accumulate in the root tip. Procedure: Twelve (12) radishes were grown for three (3) weeks, twelve were grown for six (6) weeks, and twelve were grown for nine (9) weeks. In each group of twelve, four (4) radishes were fertilized with Philorganic sludge, four with Milorganite sludge and four were not fertizlized as the control. At the end of each time period, the radishes were digested and analyzed for Cadmium and Lead content. Using this procedure, the amount of accumulation could be determined between the third, sixth, and ninth week. The potting soil and both sludges were also digested and then analyzed. Results: The Milorganite radishes accumulated the most Cadmium and Lead, the Philorganic radishes accumulated a lesser amount, and the control radishes accumulated the least amount. Consequently, the Milorganite sludge contains more metals than the Philorganic sludge. Conclusions: Cadmium and Lead to accumulate in the root tip of sludge-fertilized radishes. Once more data are gathered, the level of toxicity will be determined and all data will be submitted for statistical analysis. Application: This project suggests that caution must be used when using sludge as a fertilizer on edible plants and if toxicity is reached, sludge connot be used safely as a fertilizer.

#Third Award - General Motors ISEF

#DISTINGUISHING GRASS SPECIES USING EPIDERMAL LEAF IMPRESSIONS IN CYANOACRYLATE ADHESIVES

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The objective of this project was to develop a new method to identify closely related plants using epidermal characteristics of leaves. Identification of plants normally requires the presence of reproductive structures. Other parts of the plant such as leaves, fruit, stems, and roots are also used as aids in identification. I found that epidermal characteristics of leaves could be distinguished using a new technique of making imprints of leaves in cyanoacrylate adhesives on glass slides and viewing them with a light microscope. Differences in cell size and shape, along with patterns of the stomata and the presence or absence of trichomes and other structures were easily distinguished. This technique is inexpensive, easy to perform, and requires a portion of the plant which is normally present throughout the growing season. This is an advantage over the use of flowers, which are present for only a portion of the life cycle. The adhesive impressions are stable, and can be stored for a long period of time. Grasses were selected for this study as they are one of the more difficult groups of plants to identify. Utilizing the differences in surface characteristics, it was found that different species of grasses could be identified. A key for identifying specific grasses from epidermal impressions was developed.

#First Award - Eastman Kodak Company

THE EFFECTS OF VARIOUS NUTRIENT RATIOS IN HYDROPONIC GROWING

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Hydroponics is a system of growing plants in water containing dissolved nutrients rather than in soil. Because you have removed the soil, you must supply the root support and necessary nutrients. Hydroponic systems possess many advantages such as a higher crop yield per space and the ability to produce crops in otherwise poor conditions such as infertile soil or lack of water.

The purpose of my experiment was to demonstrate the basic principles of hydroponics and to determine which nutrients, and in what ratio, are most advantageous to the proper growth of plants. The three main nutrients needed by plants are Nitrogen, Phophrous, and Potassium. Nitrogen is influential in the growth of the stem and leaves. Phosphrous aids in the development of flowers, fruits, and healthy roots. Potassium is important in the assimilation of energy produced by photosynthesis. I used three types of houseplants, grown in water with gravel for root support. The nutrient solutions I added were commericially manufactured plant foods having three different ratios of the main nutrients: 10-15-10, 1-2-1, and 10-10-5. I regulated the pH level to ensure that all nutrients were chemically available to the plants.

After four months, the results showed that two of the three groups of plants grew better in the 10-15-10 ratio group. Not only were they healthier but larger than the other plants.

CHEMISTRY

#DETERMINATION OF pH TITRATION CURVE SHAPES USING AN AUTOMATED pH METERING SYSTEM

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The purpose of this project was to determine the curve and derivative shapes of acid-base titrations through the use of an automated pH metering system. To accomplish this, I developed both software and hardware necessary to automate a common pH meter. This included: researching and understanding various methods of interfacing, writing appropriate software, understanding and applying the theory of pH and acid-base titrations, overall apparatus design and set-up, and collection of data. The data was then graphically analyzed and the results are as follows: strong acid and strong base titrations yielded a steep curve as the endpoint was approached, strong acid and weak base titrations yielded a curve with a lower slope, weak acid and weak base titrations were correspondingly lower, and polyprotic acids had several transition points which were equal in number with the number of removable hydrogen ions of the acid.

#Honorable Mention - American Chemical Society

CHARACTERISTICS OF MOTIONLESS WAVES

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It has been found that when certain chemicals are mixed together they may form more than one compound, and that mixture can oscillate between two different chemical entities. If an indicator is added, this oscillation can be viewed by colors switching back and forth. Oscillating chemical reactions were first discovered in 1958 by Russian chemist B.P. Belovsov, whose initial ingredients were potassium bromate, ceric sulfate, and citric acid in dilute sulfuric acid, oscillating from colorless to yellow. Mixtures since then have alternated from red to blue, violet to blue, red to green, and colorless to gold to blue. The solution I am concerned with involves sodium bromide, sodium bromate, malonic acid, concentrated sulfuric acid, and ferroin dye, changing from red to blue. When the solution is stirred, bulk oscillations occur. If the solution is not bothered, another phenomena takes place. Chemical waves are developed, differing from ordinary physical waves. These waves are brought about by minute particles or scratches on the surface of the container. As wave fronts meet, instead of passing through one another, they are destroyed. With the bulk oscillations, I investigated the effects of temperature and time from initiation on the period of the oscillation. I also tried to determine the ingredient which broke down once the mixture reached fifty-five degrees Celsius; it appeared to be the sodium bromide solution. I am continuing to investigate the effects of pressure and magnetism on the oscillations and am constructing a bromide sensitive electrode to track the bromide concentration.

RADIOCHEMICAL DETERMINATION OF POTASH CONCENTRATION IN FERTILIZER

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The purpose of this research was to develop a radiochemical method of determining the concentration of soluble potash (K_2O) in fertilizer. Such a method was designed using equipment in the Environmental Engineering Department at the University of Florida. A germanium-lithium scintilator was used to monitor the emission of gamma rays from samples of fertilizer. These rays were then sorted according to their wavelengths by a multichannel analyzer, the Nuclear Data 66, and the number of gamma rays emitted with an energy of 1460.8 KeV during a fixed period of time was recorded. The gamma rays with this energy were the result of disintegrations of potassium-40 nuclei. The rate of these gamma emissions was then multiplied by an empirical constant to find the concentration of potash in the sample. The researcher calculated this ratio to be 1.480224×10^{-2} g-K_2O / pCi-^{40}K. This evaluation and statistical analyses were facilitated by BASIC software written on the IBM PC.

Seven smples of commercial fertilizer were analyzed using this method. The labeled concentrations of potash on these samples was found to differ from the true concentrations by an average of 1.83% K_2O. In all cases, however, the labels underestimated the true concentrations. Only one of the samples was found to be labeled within three standard deviation units of the true contrations of potash. This research has successfully created an accurate dry radiochemical analysis which eliminates the need for cumbersome chemical isolations.

IDENTIFICATION OF MONOTERPENE ISOMERS BY COMPUTER ALGORITHMS

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Identification of mono-terpenes from mass spectral data is a difficult task because of their relatively similar structures. In addition, mono-terpenes fragment into similar intermediate ions at an early point in the analysis and differences in calibration of mass spectrometers can alter ion intensities. A library of mass spectral data for 10 mono-terpenes was compiled and digitized. Mass spectra for five of the compounds were obtained from other sources and used as unknowns in the analysis. Eight similarity measures (including the commercially used Presence/Absence method) were selected to test these data. These methods were coded into a program which calculated the relative similarity for the five unknowns and each entry in the library. The results indicated that unequivocal identification of mono-terpenes can be obtained by several of the similarity measures tested. However, the Presence/Absence method correctly identified only 3 of the 5 unknowns, mis-identifying two unknowns by finding identical similarities to more than one library compound. This demonstrates the major weakness of this method in that it does not use ion intensity in the calculations. The most accurate similarity measure was the Manhattan Metric with a divisor of MAX (y1,y2). By increasing the size of the standard library and through further testing, the accuracy of identifying mono-terpenes and compounds from mass spectral data can be greatly increased.

CHEMILUMINESCENCE: A PROMISING ANALYTICAL TOOL

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Chemiluminescence is the combining of chemicals to produce light without producing heat. This phenomenon is useful in determining concentrations of solutions. Initial work involved determining various factors that would yield maximum chemiluminescence. In the experiments, reactions involving luminol as the oxidant and various other solutions as the catalyst produced the chemiluminescence. To record levels of chemiluminescent intensity a phototransistor was attached to an Atari computer. The computer was programmed to detect the changes in light intensity every 1/60th second and to save it onto a disk for future analysis. To study the effect of concentration on chemiluminescent light intensity several serial dilution experiments were performed using a limited range of concentrations of $K_3Fe(CN)_6$ solution. A direct relationship between catalyst concentration and light intensity was obtained. When other catalysts were used, different events occurred. At higher concentrations the intensity would increase as the concentration decreased, but at lower concentrations it would decrease with decreasing concentrations. This was due to precipitate blocking light. When analysis using just the peak intensities proved fruitless, the entire decay curve was incorporated. For $K_3Fe(CN)_6$ the decay was exponential, but for other solutions the decay was complicated by the precipitate. Because the luminol concentration is constant, the same amount of light is always outputted. The only factor changing is the rate of decay. An equation with four variable parameters, one of which is the rate of decay, was produced. This rate allows determination of the concentration of the catalyst.

ORGANIC ACIDS IN A SOLAR CONCENTRATION CELL

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This device converts sunlight into usable electric power. The solar concentration cell has potential over photovoltaic systems in that it serves as its own battery and does not require the addition of a storage facility to allow the drawing of power during periods of darkness. The construction of the cell is inexpensive, especially in comparison to current photovoltaics. There exists, however, a major problem in that the cell has a very high internal resistance. An attempt has been made to alleviate this, increasing the output of the cell.

The cell itself consists of two halves separated by an ion exchange device. Both a salt bridge and an anion exchange membrane were used. One half of the cell is shielded, and to that side is added an excess of solid acid. Both sides are filled with a solution of the acid, and the entire cell is exposed to ultraviolet light. The trans to cis reaction proceeds at a faster rate than the reverse on the exposed side, and, as cis-acid solutions have a higher pH than those of trans, there develops a hydrogen ion imbalance within the cell. This results in the migration of the cis-anion to the shielded side where it is deposited as the solid trans-acid upon the transfer of the electron through the electrodes, producing a current.

The potential for the cell is small, under 100 millivolts, and the efficiency has been calculated to be less than one percent, but it must be considered that the acids used, urocanic, maleic, and cinnamic, absorb in the ultraviolet range. A search is to continue to develop a cell with operating efficiencies near those of photovoltaics through the use of other chemical systems.

#KINETIC CATALYSIS OF THE IODINE CLOCK REACTION

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The purpose of this project is to determine which metal ions, if any, catalyze the iodine clock reaction. Using the results obtained through experimentation, possible explanations as to why or why not the metal ions catalyzed the reaction will be proposed.

Seventeen metal ions were tested for catalytic effect; the ions were each introduced into the reaction three separate times, the reaction rates were then averaged. This project consisted of six phases. In Phase One, only the metal ions were used in the reaction. In Phase Two, 16M nitric acid was introduced into the reaction to prevent the metals from oxidizing and to keep the pH constant. In Phase Three only the ions that had a catalytic effect (Cu^{++}, Fe^{++} and Fe^{+++}) were tested; their concentrations were reduced by one half. In Phase Four, only the Cu^{++} ion had ammonia introduced into the reaction to see if the ammonia (a complexing agent) had any effect of the catalytic effect. In Phase Five, EDTA was introduced into the reactions with the metal ions that had produced a catalytic effect to determine if the EDTA (a strong complexing agent) would stop the catalytic effect. In Phase Six, the effect of ionic strength was tested. Four different concentrations of KNO_3 were introduced into the iodine clock reaction. The ionic strength was also tested using the metal ions that had displayed a catalytic effect.

Using the results obtained, it was concluded that the Cu^{++}, Fe^{++} and the Fe^{+++} ions catalyzed the reaction. One theory as to why this happens involves the Jahn-Teller Effect. It is proposed that the distorted octahedral shape is a factor causing the catalysis. Another hypothesis is that the ions, which act as homogeneous catalysts, bond to one of the reactants to form a new complex, This new complex then combines with the other reactant in such a way that a lower activation energy is produced, thus catalyzing the reaction. It was also concluded from the results obtained that as the ionic strength increases the rate of the reaction also tends to increase.

#Honorable Mention - American Chemical Society

BIOMASS GASIFICATION: THE PRODUCTION OF METHANE FROM WOOD WASTES WITH THE USE OF SOLAR ENERGY AS A POTENTIAL HEATING SOURCE

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This project is dealing with the production of methane from wood wastes. The tests were designed to determine first, if it is possible to produce methane from wood wastes, then to determine which type wood produces the higher percentage and finally, to determine if direct solar radiation could be used as a heating source during the gasification process.

The two woods used were; Pine representing softwood, and Oak representing hardwood. Spanish Moss was also used.

The experiment is dealing with the dry heating of wood in the absence of air. Temperatures, percentages and heating times were looked at. The results show that Oak (Turkey) yielded the highest percentage of methane. The second highest percentage was that of Pine--Long Leaf. It was discovered that the temperature, volume of wood and time of heating affected the production of gas.

The water used in the condensing and transfering of gas was also analyzed. The results show that the pollutant level is directly related to the amount of tar produced during gasification. The use of solar radiation as a heating source was tested. Although weather patterns and sun position affected the test, positive results were achieved.

This system of producing a fuel-gas from wood wastes can have a low cost or possibly a negative cost of production. Tar and light oils are produced as a by product. These can be captured and put to other uses. The chared remains of the wood upon further heating can become charcoal, leaving no waste products. The use of Biomass still needs further development, but this system certainly is not worse than others in use today.

THE KINETIC ORDER AND RATE OF OXIDATION OF ASCORBIC ACID WHEN CATALYZED BY OXYGEN

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Although very little is known about the loss of ascorbic acid (more commonly known as vitamin C), through original research I have concluded many things about the oxidation of this important vitamin. In past years, I have concluded that the addition of various elements, exposure to varied conditions, and the exposure to a buffer system all affect the rate of oxidation of ascorbic acid. I researched the chemical equation for the loss of ascorbic acid and found it to be an oxidation reaction:

$$2C_6H_8O_6 + O_2 \rightarrow 2H_2O + 2C_6H_6O_6$$

(ascorbic acid + oxygen → water + dehydroascorbic acid)

This year's project focuses on accurately testing the catalytic effect of oxygen on the oxidation of ascorbic acid.

When I first tested this reaction for a kinetic order two years ago, I found the reaction to be second kinetic order. This year I controlled the oxygen flowing into the system and observed psudo first kinetic order, because the controlling factor, oxygen, was kept constant. These findings concur with previous researched findings and also with other personal laboratory experiments. I have also proposed that the rate determining step in the oxidation of ascorbic acid has one ascorbic acid molecule react with one molecule of oxygen to produce an intermediate compound which goes through many yet undetermined steps to complete its deterioration into dehydroascorbic acid. The final order was determined to be second kinetic order, and the observed rates of oxidation were influenced by oxygen so that the higher percentage of saturation of oxygen in a vitamin C solution, the faster the reaction takes place.

VARYING REACTANT CONCENTRATIONS IN GLYCINE SYNTHESIS

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Glycine is an amino transmitter in the nervous system which can be chemically synthesized from monochloroacetic acid and ammonia. Varying the ratios of monochloroacetic acid and ammonia produce different amounts of glycine.

In this project I varied the amounts of reactants to find the ratio that would produce the most glycine. In doing this I kept the total amount of reactants the same, but varied the amount of each. In my experiments I found the best combining ratio to be 34 grams of monochloroacetic acid and 70 grams ammonium carbonate. This does not mean that a 34:70 ratio will necessarily give optimum results, but the ratio would be within a 10 gram range.

I tested my product in two ways. The first way was with ninhydrin for a protein. After I identified my product as a protein, I used paper chromatography to identify it. I tested my product against another amino acid, alanine, and a sample of known glycine. My product and the known glycine stopped at the same level; the alanine stopped at a different level. These tests show that not all amino acids stop at the same level and that my product is probably glycine.

COMPUTERIZING THE MOLECULAR ORBITAL THEORY TO DETERMINE CERTAIN CHARACTERISTICS OF DIATOMIC MOLECULES

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The focus of this project deals with the molecular orbital theory. The theory says that electrons exist in molecules in fixed energy states known as molecular orbitals. A molecular orbital is a result of a combination of two atomic orbitals. This method is called the linear combination of atomic orbitals or L.C.A.O. From this, two kinds of M.O.s, a bonding orbital and an antibonding orbital, are formed. Both of the bonds represent a volume of space that is found around the molecule. In the M.O. method, a head-to-head overlap of two atomic s-orbitals or a s-orbital and a p-orbital or two p-orbitals will give a sigma bond (σ) and a sigma antibond (σ^*). A side-to-side overlap creates a pi bond (π) and a pi antibond (π^*). To fill the molecular orbitals, the total number of electrons is used. The Aufbau Principle allows it to be filled in increasing order. The arrangement begins with $(\sigma_{1s})(\sigma_{1s}^*)(\sigma_{2s})(\sigma_{2s}^*)(\pi_y)(\pi_z)(\sigma_{2p})(\pi_y^*)(\pi_z^*)(\sigma_{2p}^*)$. The Pauli Exclusion Principle limits a maximum of two electrons per orbital.

The use of an Apple IIe microcomputer and the molecular orbital theory will determine certain characteristics of diatomic molecules, specifically those of homonuclear and heteronuclear molecules. Homonuclear molecules have only one type of atom whereas heteronuclear molecules have two different kinds of atoms. Some aspects of the molecule such as the kind of bond, the electronic structure, and the bond energy will be found. Because the M.O. method is limited to its accuracy, approximations are utilized to derive a quick and satisfactory description of the given formula.

EFFECT OF HEAT AND CONCENTRATION IN ACID HYDROLYSIS OF CELLULOSE

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A search for optimal conditions in production of glucose by acid hydrolysis was conducted with sulfuric acid as catalyst. The maximum sugar recovery occurred between 9.00 and 13.50 molar acid in the equally heated samples.

A VISCOMETRIC STUDY OF POLYSTYRENE DEGRADATION

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Disposable polystyrene cups are a common sight in today's world. They are everywhere. Unfortunately, one of the most common places where they can be found is on the ground. Polystyrene cups are supposedly 'degradable', but are they really?

This experiment uses viscosity measurements and calculations on those measurements to determine the average molecular weight of the polystyrene in the cup. The average molecular weight of a standard cup is compared to that of treated cups to determine if the polystyrene is really degradable.

Polystyrene cups were subjected to ozone, ultraviolet light, and a natural environment. All the treatments were preformed over the same time interval. The viscosities of the solutions were converted to average molecular weights. Then, using a few statistical tests, the molecular weights of the standard cup and the treated cups were compared and it was determined within a certain confidence interval whether degradation did occur.

From the data gathered and the calculations preformed on them it was found that detectable degradation did occur over the period in which the cups were treated. If further research would indicate that this degradation continues over a longer time period, then the polystyrene cup truly is a desposable cup.

XENONTETRAFLUORIDE

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INTRODUCTION: Xenon is a member of the noble gas family which is regarded as generally inert. However, in 1962 scientists at the Argonne National Laboratory discovered the "activity" of xenon compound could be produced under special conditions.
The purpose of this investigation was to develop the apparatus and procedures for the production of the noble gas compound-xenontetrafluoride (XeF_4).
HYPOTHESIS: If xenon can be caused to be chemically active then it should show such chemical activity under conditions of high pressure and high temperatures in the presence of very reactive fluorine gas.
PROCEDURE: A nickel-plated reaction chamber, from which as much air as possible was evacuated using a vacuum pump, was pressurized with xenon gas at 25 PSI and fluorine gas at 120 PSI. The reaction chamber containing these gases was heated to approximately 450°C and maintained at that temperature for half an hour. After being cooled overnight, the chamber was opened inside a ventilation hood and dismantled. The reaction products were then removed from the chamber.
RESULTS: The products were placed in a petri dish and weighed. With a mass of 0.5 grams, the products were found to contain a mixture of mostly nickel, iron, manganese, copper, and titanium oxides. However, with these oxides were crystals of clear pinkish hue which were identified to be xenontetrafluoride crystals by Dr. Robert Summers of Atlas Chemical Testing Laboratories included using polarized light and qualitative analysis.

ALUMINIUM ELECTRODES

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This research involved the discovery, examination and explanation of the peculiar electrochemistry of a simple cell constructed of two aluminium electrodes in a salt water solution. The cell is a weak battery, but electrically is radically different from other simple cells. During the first few moments of charging the resistance varies dramatically. Discharge is, however, the stage in which the cell behaves most peculiarly. Over a period of hours the cell is capable of spontaneously reversing polarity. It was found that the cell can be "programmed" by the method of charging to change from one polarity (chosen by the experimenter) to the other in only a few seconds. If the solution is acidified the cell responds by always discharging at the reverse polarity to that of the charging supply. The change of polarity here is within a fraction of a second. A study of relevant texts revealed that polarity reversal of any type for such a cell is an entirely new phenomenon. No effects of this type were observed when other metals were used. Observations were made using a cathode ray oscilloscope. The major reactions were found to involve the oxide layer of aluminium, its reaction with chloride ions in solution, and the reaction between aluminium metal and the hydroxide ions present after charging. The response of the cell to acid is suspected to be due to the reforming of the oxide layer after charging. It appears that a more detailed analysis of this new aspect of aluminium electrochemistry using better equipment should uncover new applications for the metal.

#Third Award - General Motors ISEF

THE INFLUENCE OF LIGHT ON THE DEGRADATION OF RIBOFLAVIN IN FOOD

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My project deals with how much riboflavin in food is lost when exposed to light. In last year's project, I proved that riboflavin (vitamin B_2) degraded quite rapidly when exposed to light, especially high intensity light, such as sunlight. I also found that some colors of light degraded riboflavin faster than others. In this year's project, foods containing riboflavin (milk, broccoli, and liver) were tested directly to find the exact effect of light on the quantity of riboflavin in food. This was done through a fluorometric assay procedure in which fluorescence was measured to determine the quantity of riboflavin in a given sample. This year's project also involved measuring the degradation of pure samples of riboflavin when exposed to different wavelengths of light from a monochrometer. This was done by observing the riboflavin directly in a spectrophotometer. My conclusions are:

1. A 24 hour exposure of fluorescent light won't decrease the riboflavin content in food.
2. Cooking will decrease the riboflavin content in liver.
3. Sunlight will decrease the amount of riboflavin in milk by about 50% over 24 hours.
4. Riboflavin degrades fastest when exposed to a light wavelength of 475nm (green blue).
5. Riboflavin in pure solution degrades faster than riboflavin in food.

#THE SYNTHESIS OF ANTI-CANCER DRUGS FROM PLATINUM COMPLEXES

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Metal coordination complexes have been used as anti-cancer drugs since Barnett Rosenburg accidentally discovered cis-dichlorodiammine platinum (II) (cisplatin) during experiments on Escherichia coli. The complex effectively inhibited cell division in the bacteria, thereby causing filamentous growth.

In this project important second generation drugs of cisplatin were synthesized using less expensive methods than in U.S. patents 4137248, 4140707, 4175133, and 4322362. Also three new, unpatented complexes were synthesized. These were potassium, copper and magnesium salts of hydroxymalonatodiammine platinum (II), a derivative of cisplatin. These salts may increase solubility and decrease toxicity of the parent complex. Each complex synthesized was tested on E. coli since the reaction of the bacteria to a known anti-cancer agent has been established by Rosenburg. All complexes effectively inhibited cell division in bacteria, indicating possible anti-cancer activity. The new complexes will now be sent to a national firm for tests in laboratory animals.

#First Award - American Intellectual Property Law Association
First Award - General Motors ISEF
First Award - United States Air Force
First Award - United States Navy/Office of Naval Research
Second Award - American Chemical Society
Second Award - United States Army
Alternate - Glenn T. Seaborg Nobel Prize Visit Award

PHOTOELECTROCHEMICAL CELL

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A Photoelectrochemical cell converts light to electrical energy. These cells are used in space and on earth to convert solar energy to electrical energy. There are many factors which affect the optimum production of current in this type of cell. Some factors are the molarity of the solution, heating the titanium rod at different amounts of time, and the distance of the light source from the solution. This study was to determine under which conditions mentioned, the photoelectrochemical cell will produce the greatest amount of current. The experiment consisted of a photoelectrochemical cell made of different molar solutions of sodium hydroxide, a titanium rod cathode, and carbon anode. The cell was placed in series with a mA. A 25 watt incandescent bulb was used as a light source. The breaker was covered with black construction paper with a 1 cm by .6 cm hole 2.3 cm from the bottom. The current was recorded as soon as the rod was placed in the concentrations of sodium hydroxide, it was found that the 40 molar solution produced the most current (735 mA). As the heating time for the titanium rod increased, the current increased and then decreased. The most current produced (500 mA) was when the rod was heated for 16 minutes of heating time. When the light was moved from the solution, the current increased and then decreased both times. A peak might have been reached when the light was 12.5 cm away because the most current (295 mA) was produced at that point.

#A CHEMICAL RESEARCH APPROACH TO TAXONOMIC VARIATION IN CITRUS

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This research study was undertaken to determine what chemotaxonomic markers could be found through the examination of the chemical constituents of six Citrus fruits: the Citrus sinensus, C. paradisi, C. limon, C. aurantifolia, and C. reticulata.

The flavonoid molecule (2-phenyl-1,4-benzopyrone) was used as the target compound.

The rind of each of the six fruits was removed and weighed. A mixture of 50% isoPrOH was added in a ratio of 2.5ml/g. This mixture was removed and filtered.

Approximately 20μg of each of the six resultant filtrations of the fruits was spotted on strips and run in 6 different solvents: BAW (4:1:5), $CHCl_3$-sec-BuOH-H_2O (2:4:4), isoPrOH-H_2O (2:8), isoPrOH-H_2O (6:4), and HOAc-H_2O (15:85). Spots were circled under UV light and R_f values were calculated.

IsoPrOH gave the best separation, thus, varying mixtures of isoPrOH were screened and 70% isoPrOH was found to yield the greatest separation. This system was then used to establish the presence of a chemotaxonomic marker.

The remaining filtrates were run through column chromatography to separate and identify individual flavonoids using ECTEOLA-cellulose as the medium. The fractions were analyzed by UV-spectroscopy (Beckman DU-3) using 95% EtOH as the blank. Final identification of each flavonoid was made showing a positive relationship of flavonoid type and structure to taxonomic variation.

#Fourth Award - General Motors ISEF

#AN INVESTIGATION OF THE PROPERTIES OF AQUEOUS SOLUTIONS OF CHLORINE DIOXIDE WITH SUGGESTIONS FOR PRACTICAL APPLICATION

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Chlorine dioxide is a free radical and as such has many unusual properties. The properties determined were decay constant, molar absorptivity, rate law, equilibrium constant, Gibb's free energy, and activation energy. The area of water treatment was studied for possible application.

The problem of derermining chlorine dioxide concentration was solved by using a redox iodiometric titration, using Beer's law a molar absorptivity value was obtained. The decay constant was determined by plotting a graph of the log of chlorine dioxide concentration versus time. The slope of the resulting line was a value called $K_s$observed. A buffer system was established to determine the effect of hydrogen ion concentration. The rate law was determined by a graph of the log of chlorine dioxide concentration versus time. Since this was a straight line, the decay constant could be calculated. This straight line also indicates that the decomposition reaction is first order with respect to chlorine dioxide concentration. The equilibrium constant was determined and Gibb's free energy was determined from this value. The activation energy was determined by finding $K_s$observed at two different temperatures. The decay constant was $7.31 \times 10^{-4} M^{-1} sec^{-1}$. The molar absorptivity was 340 1/Mole cm. The rate law was first order. The equilibrium constant was 1081. Gibb's free energy was -6.7×10^{3} calories, and the activation energy was 11,500 calories.

#Honorable Mention - American Society of Civil Engineers

VARIATION IN PLANT PIGMENTS

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Sunlight, which appears to be white, is really a mixture of light of all colors, each color corresponding to a specific wavelength of electromagnetic energy. A pigmented object will absorb some wavelengths of light and transmit or reflect others. The green leaf absorbs red and blue light and reflects the green-thus appearing green. Chromatography makes it possible to separate the various pigments found in a leaf. In this project two methods of separation were used 1) chemical partition - pigments separate by their difference in solubility and 2) paper chromatography-pigments separate by their relative mobility in relation to a stationary and mobile phase. Using a spectrophotometer it is possible to measure, for each wavelength, the amount of light absorbed by a pigmented solution and obtain an absorbtion spectrum by which the pigment may be identified. The pigments from four plants (beet, coleus, spinach, and cabbage) were extracted and separated by chemical separation and paper chromatography in order to determine the type of pigments in the leaf and to compare their solubility and spectral characteristics. Paper chromatography of the lipophyllic chloroplast pigments gave four distinct bands which correspond to the oxygen content of each of the pigments. After eluting the pigments from the paper they were analyzed in a spectrophotometer. The pigments obtained from the chemical partition were identified by comparing their absorption spectra with those from the chromatogram. Both methods gave the same four pigments-β-carotene, chlorophyll a and b, and xanthophyll. The additional hydrophyllic pigments found in cabbage and coleus were identified as anthocyanidins and in beet as betalains.

FUEL CELLS; THE ELECTROCHEMICAL STUDIES OF COATED PLATINUM ELECTRODES

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The purpose of this project is to find the effects of a charge on a polymer film on benzoquinone electrochemistry. First a film formed by phenol oxidation was used in a control experiment since it was neutral in charge. Three platinum electrodes were coated then tested in a cell. These results were saved to compare with later experiments. Salicylic acid was used next to produce a negatively charged coat. The film was formed easily since no other compounds were needed. Three platinum electrodes were coated and tested using p-benzoquinone as a test system. There was no significant difference between the results of this experiment and of the phenol film. Finally (2-hydroxybenzyl)triphenylphosphonium tetrafluoroborate was used for coating, being oxidized to form a positively charged film. Again three electrodes were coated and tested, giving the same results as in the previous experiments. With these results it was concluded that the fact that a coat has charge or not does not affect the electrochemistry of p-benzoquinone at platinum.

ELECTRODEPOSITION

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The electrostatic phenomena arose when the electrodeposition process was achieved by using an electrostatic Van de Graaff Generator to place cooperplate on certain metals. The object of this project was to design an electrostatic generator for the purpose of experimenting with various materials and providing a useful and sturdy tool to aid in further experiments with electroplating. These results could be compared to electroplating done with other sources of energy.

The high voltage Van de Graaff Generator was constructed in such a way that it would be a feasible and stable device to produce an adequate and regular source of static electricity. A positive and negative charge was established. Electrodeposition was attempted on eight materials using the Van de Graaff Generator for two minutes. Comparisons were made with the other sources of energy plated for this length of time. Controls were maintained.

Experimentation was done to investigate electrolysis and to test the process of copperplating various types of material. Plating was attempted using a six-volt battery on high-conductive, low-conductive, and non-conductive materials. The same controls were maintained and plating was done for varying times. Data was kept on results of plating of the various materials. Six- and twelve-volt DC current was also used. Peak time was established. The process was repeated in a heated bath of 80 degrees. Various cleaning processes were used.

It was concluded that the heated bath definitely improved the plating coat. It was further concluded that the Van de Graaff Generator was not an adequate source of energy for this experiment

CALORIE CALORIMETRY

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Purpose: The purpose of this research is to determine which food of the four food groups, due to the mean calorie content, should be decreased to lose calories (weight).

Hypothesis: The mean calorie value of one food in a food group will be equal to the mean calorie value of another food in another food group.

Procedure: Ten foods were chosen of the four food groups; with these being steak, bacon, milk, parmesan cheese, lima beans, peas, apples, apricots, granola, and rice crispies. The foods were dehydrated for the recommended amount of time. They were then finely ground in an electric blender. Each sample of food was made into five pellets using a pellet press. The pellet, not weighing over 1.5 grams was placed in an oxygen bomb calorimeter. The pellet was then ignited and burned. During the process of calorimetry data was taken in order to figure calories. At the end of calorimetry, the data was fed into a computer and Calories per gram, "large calories," were analyzed. These calories were then converted to calories per gram, "small calories." This amount was then multiplied by the average portion of food a person consumes at a regular meal.

Conclusion: There is a difference in the mean calorie value of one food in a food group to another. It was found that steak had the highest calorie content. This concluded that steak should be decreased to smaller portions to lose calories (weight).

#COMPARATIVE STUDIES OF THE DETERIORATION OF VITAMIN C IN VARIOUS SAMPLES

Greever, Mary Grace, Cleveland, H.S., Cleveland, MS 38732; 1508 Bellavista, Cleveland, MS 38732.

This, being the second phase of research over two years, had several objectives. These objectives involved the testing of components of fruit juices to see if they reacted with the DCIP and the search for a better method of finding the endpoint of the titration. A technique using a Spectronic 20 was implemented and found to be successful on some samples. Samples with much pulp and bacterial growth did not give good results. Also samples of all tested colors with the exception of reds and burgundies gave good results. Several conclusions can be drawn from these results. Firstly, it can be assumed that the previous year's results were valid. It can be concluded also that this previously unused test is a conclusive test on many samples; however, it cannot be used on all vitamin C containing products due to their turbidity and color.

#Fourth Award - General Motors ISEF

A BURNING ISSUE - FLAME RETARDATION

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PROBLEMS - (1) to test the flammable qualities of military uniforms. (2) to test and treat miscellaneous fabrics for flame retardant properties. (3) to refine 3 formulas for use on household items which would enable me to go into business for myself.

METHODS - (1) I burned samples of actual military uniforms to test the flammable properties. (2) I treated and burned different fabrics. I also treated and tested the same fabric in different colors. (3) Through experimentation I have refined 3 formulas which consist of common substances, and now treat fabric commercially in our area.

RESULTS AND CONCLUSIONS - (1) Military uniforms are highly flammable. Therefore, they should be made flame retardant. (2) Type of fabric and color will effect results; each color and fabric type must be tested separately. (3) The 3 formulas I use in my business can be used on most colors and fabrics.

VITAMIN C - INNOVATIVE ANALYZATION OF ITS DECOMPOSITION - EXPERIMENTATION WITH SIX INDEPENDENT VARIABLES

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Vitamin C, which is also known as ascorbic acid is considered a water soluble vitamin and is easily oxidized. Experimentation was completed to test vitamin C's stability using six independent variables - temperature, storage container composition, wavelength of light, gaseous exposure, gravity, and pH. Titrational analysis was used at the onset, but an innovative technique using a spectrophotometer was discovered, developed, and substantiated, and then used in all further testing. It was determined that the decomposition of vitamin C is an inevitable event and that the rate at which it decomposes can be experimentally determined and changed by the particular variable. Increased decomposition was found in cooler temperatures, plastic containers, purple light, increased gaseous exposure, and increased gravity. The pH was found to increase as decomposition occurs. Many factors affect ascorbic acid's decomposition rates and there is still much to be learned about the substance.

HOW TO OBTAIN HYDROCARBONS OUT OF TROPICAL PLANTS

Muñoz Camps, Johnny, Eloisa Pascual High School Caguas Norte, Caguas, Puerto Rico 00625

Among the many problems that concerns humanity, we find the energy shortage. There fore, we must seek other alternatives to depend on as energy source.

In my research I used 100 grms. of leaves and stems of five different tropical plants: Albizia procera, calophylum calaba, Dalbergia ecastaphylla, Ricinus communis and Manihot esculenta (only leaves were used).

The leaves were macerated in a blender with presence of 400 mls. of acetone. The extracts of filtered compounds were left in repose for 48 hours. They were filtered through by suction and put in a Brikmann R-110 Evaporator to evaporate the acetone.

In performed a column chromatography using one grm. of each one of the extracts with 20 mls. of ether. The compounds were separated in polars and no polars (hydrocarbons). Also a gas chromatography, analysis of combustion, and study of infra-red were performed.

I used 5 mls. of viscous oil obtained from the filtered compound, some strips of paper were covered with the compound, applying flame to carry out a comparative study of combustion.

The results showed hydrocarbons of different molecular weights. In the calophylum calaba (1) nonane and decane samples of hydrocarbons were identified. Hydrocarbons of heavy molecular weight were found in other plants.

In conclusion, the five tropical plants can be used to obtain hydrocarbons.

My future projection is to carry studies on NMR and chromatography of fractions to verify the obtention in great scale of hidrocarbons.

#First Award - United States Air Force
First Award - U.S. Department of Energy
Fourth Award - General Motors ISEF

STOP! YOU MAY BE USING THE WRONG DETERGENT

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Many detergents advertise having various cleaning abilities. The purpose of this project is to learn which detergent is the most economical in removing oily dirt and cleaning various stains. Fresh Start is advertised as having the convenience of a powder and the stain fighting power of a liquid. Since the claims in other detergent advertising are not as strong, the hypothesis of this experiment was that Fresh Start would be the most economical in emulsification and stain cleaning.

The basic procedure was this:

1) Make the five stains: grass stain, sandwich stain, mud stain, and chocolate stain.
2) Stain the cloth.
3) Prepare detergent/water mixture and test for emulsification.
4) Wash the cloth and rate the stains according to how well they have been cleaned.
5) Evaluate and graphically present the results of the above tests.

The conclusion of this experiment is that out of the eight detergents tested All was best in overall effectiveness for economically cleaning stains and removing oily dirt.

#INFRARED RADIATION - A TOOL FOR ION DETECTION

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A colored system's ionic concentration can be determined by its color intensity, but this technique is not possible in a clear solution. Inexpensive infrared spectrophotometers which can determine a clear system's ionic concentration are quite costly. I wanted to build a very low cost instrument to detect a system's ionic concentration regardless of the system's color or clarity.

I have built such an instrument. I interfaced a photoresistive chip to my computer's joystick input via a two-transistor amplifier circuit. I wrote programs to aid in my experimentation. Once I started an experiment, my computer would read, process, and display the experiment's results. I performed over 150 experiments using 15 various colored and clear solutions. My computer processed over a hundred thousand pieces of data and displayed the results on over 100 charts and graphs.

From my experiments, I proved that my sensor could detect a system's ionic concentration to levels ranging from a hundredth to a millionth of a mole in both clear and colored solutions. Furthermore, I proved that the infrared absorbancy of a system is directly proportional to the system's ionic concentration, the humidity of the system's environment, and the square of the distance from an infrared source. Finally, I found that as a solution absorbs infrared radiation, it rises in temperature and its absorbancy decreases. My experimentation opens the door to further work in infrared spectroscopy which can determine a single ion's concentration in a multi-ion system.

#First Award - General Motors ISEF

#OBSERVATION OF THE POSSIBILITY TO PRODUCE FUELS THROUGH PYROLYSIS OF ASCLEPIAS SYRIACA

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The purpose of this project was to find out if pyrolysis of Asclepias syriaca (common Milkweed) would yield gaseous, liquid and solid fuels which would be interchangeable with fuels from fossil energy sources.

As a green plant A. syriaca uses photosynthesis to convert light energy into chemical bond energy. Cellulose and other polymers are produced in this way. They can be broken down into their subunits by pyrolysis.

Pyrolysis involves heating of the biomass in the absence of oxygen which yields solid, liquid and gaseous products.

The pyrolysis of A. syriaca yielded:

a) a combustible brownish liquid (42.6%)
b) a combustible gas (27.2%)
c) a black residue of charcoal

These products could be used directly as fuels or to produce other fuels with more convenient properties. Even though fuels produced in the way described in this project might be more expensive than 'traditional' fossil fuels are today, the products of pyrolysis of A. syriaca might be interchanged with fossil fuels to preserve their limited resources or may be used to replace them totally.

#Third Award - General Motors ISEF

#MICELLE STABILIZATION OF A FLUORESCENT COMPOUND

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A fluorescent compound was synthesized using nitrogen-methylated vitamin B_1 and a fragment of ribonucleic acid called cytidine. During hydrolysis in aqueous solution, the compound is destroyed by hydroxide ion. This reaction was monitored in a spectrophotometer at 390 nm using carbonate/bicarbonate buffers. Rate constants were determined by plotting the logarithm of the absorbance changes vs time and then calculating the slope.

To retard the rate of hydrolysis, sodium dodecyl sulfate (SDS), a surfactant which forms anionic micelles, was introduced. Retardation first increased sharply and then leveled as the SDS concentration increased. At 0.10 M and above, maximum protection occurred as all fluorophore was bound to micelle. Under these conditions, hydrolysis was 11 times slower than in micelle-free solutions.

With the aid of a computer program the kinetic data yielded a binding constant (12,000 M^{-1}) describing the attachment of the fluorophore to the micelle. An independent method, using fluorescence spectroscopy, was also used to determine this constant.

Thus, adding SDS is an effective means of protecting the fluorescent compound against hydrolysis. Furthermore, other interesting and important conclusions applicable to organic compounds follow from this study.

#First Award - American Chemical Society
Second Award - General Motors ISEF
Second Award - United States Air Force

INDICATORS FROM INTENSE COLOR FLOWERS

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Indicators are organic compounds or complex structure that change in color due to the pH of the solution they are in contact. The purpose of this research was to determined if the petals of colored flowers can be used as indicators due to their intense color. 1.00g of the petals of each flower were deposited in ten test tubes and two (2) ml of 70% isopropyl alcohol were added to each tube. The tubes were placed in a hot water bath and boiled for several minutes until an intense color extract was obtained. This extracts were tested with HCl, distilled water and NaOH were measured and deposited in test tubes and two drops of each flower indicator were added to each one. The colors of each flower indicator in each solution was observed, the pH range was determined and the color in acid and alkaline medium was established. Also paper chromatographice were carried out for each indicator extract in order to determire if it consists of more than one color. The tests showed that all the extract of the flowers can be use as indicators sinse they change in color at different pH and have one color in a acid medium and another in alkaline medium. Comparing the range in what this extracts change with the pH range of commercial indicators it was founded that almost all the commercial indicators can be substituted by the indicators obtained from flowers of intense color.

#VICARIOUS SUBSTITUTIONS OF NITRO AROMATIC COMPOUNDS IN THE SYNTHESIS OF 5-SUBSTITUTED BENZIMIDAZOLES; POTENTIAL ANTIFILARIAL AGENTS

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Filariasis is a crippling, parasitic disease caused by nematode worms that affect several hundred million people in tropical and subtropical regions of the world. The disease is most widespread in nations that can least afford the direct economic burdens of the disease or its adverse nutritional consequences.

In the last decade, benzimidazole carbamates have been shown to be potent, broad spectrum filaricides. However, progress in the use of benzimidazoles was hampered by a lack of absorption and bioavailability when these drugs are administered orally. Therefore, the objective of this project has been to develop a new synthetic methodology for the preparation of new polyfunctionalized, five-substituted benzimidazole carbamates which should be more water soluble, and therefore more bioavailable orally for use as potential antifilarial agents. The initial reaction is the key step in this synthetic sequence, and involves an unusual nucleophilic substitution on an aromatic ring. In this reaction, the leaving group at the site of substitution is a hydrogen anion. The usual nucleophilic substitution on an aromatic ring necessitates that the aromatic ring have a substituent, such as a chlorine or bromine atom at the site of substitution. This type of reaction proceeds via an addition of a nucleophile to the site of substitution on the aromatic ring resulting in a σ-complex which subsequently loses the leaving group as an anion furnishing the substitution product. Using this methodology, various new substitutions at the 5-position of the benzimidazole ring system may be made, and it is now possible to prepare many new benzimidazole carbamates as potential antifilarial agents.

#First Award - American Medical Association
Operation Cherry Blossom - United States Army
Scholarship - United States Navy/Office of Naval Research
Fourth Award - General Motors ISEF

ACIDS AND BASES

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My project is divided into two tests involving acids and bases. The two tests are labeled "test 1" and "test 2."

Test 1 is a display of how an alkaline indicator works. I used alcohol to extract phenolphthalein, an alkaline indicator, from Feen-A-Mint laxative. I added the phenolphthalein to ammonia and the ammonia was turned red by the indicator. This proves that an alkaline indicator is used to detect the presence of an alkaline in a certain substance.

Test 2 is a test to determine if electricity can be used to measure the general strength of an acid. I used two 6-volt batteries to supply the electrical charge. I ran the negative charge directly to a 12-volt headlight and ran the positive charge to the headlight and then cut that wire into. I placed sulfuric acid, diluted to 33% acidity, in a jar. I placed the wire from the headlight into the acid and then placed the positive charge, from the batteries, into the acid. The acid carried the electrical charge to the other wire and the light was illuminated. I tried a weak acid and the light would not come on. This proved that the stronger the acid, the better the circuit would be completed. This also proved that the general strength of an acid can be tested by how well it conducts electricity.

THE PHENOMENON OF LIESEGANG RINGS

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The phenomenon of Liesegang Rings was first reported by a colloid chemist and photographer, Liesegang. During their early period of popularity, Liesegang Rings were credited for many of nature's banding phenomena. Later, enthusiasm faded for the idea, and the cause for Liesegang Rings has never been determined. This research has been many faceted, as new discoveries along the way have altered its course. Two different gel media were used in which to develop crystals through the reaction between two chemicals. Liesegang Rings were demonstrated in both gels, but with widely varying properties and behaviors. As a result of this study, it is suspected that solubility products may have a direct relation to the pattern formation and behavior of Liesegang Rings in media like the ones described.

PHEROMONE, A SOLUTION TO FUTURE PEST CONTROL

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Pheromone, the chemical messenger of the insect world, has become a major area of study of organic chemist in the last few years. Interruption of the insect pest's life cycle by the use of minute amounts of these natural specific attractants offer an alternative of control to insecticidal spraying. In this experiment, a certain type of pheromone, sulcatol 6-methyl-5-hepten-2-ol (an aggregation pheromone), is studied.

An alcohol product of this pheromone is obtained by a chemical reduction reaction using 6-methyl-5-hepten-2-one (ketone) as a starting agent.

Field testing indicates that the synthesized pheromone (sulcatol) is sucessful in attracting ambrosia beetles.

#Fourth Award - General Motors ISEF

#A KINETIC STUDY OF THE DECOMPOSITION OF ASPARTAME AND THE PRODUCTS FORMED AND THEIR DETERMINATION BY HIGH PERFORMANCE LIQUID CHROMOTOGRAPHY

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In order to develop an HPLC method to detect aspartame and its major decomposition products, three parameters were investigated. These were the pH of the mobile phase, wavelength of detection, and amount and type of organic modifier in the mobile phase. Using this technique rates constants at pH 2 - 8 were calculated at 50; and at pHs 3.0, 5.6, 7.8 activation energies were calculated. Aspartame was most stable at pH 4 and the rate of decomposition was faster at pHs above and below 4. Additionally, at pHs below 4 the major decomposition products detected were the dipeptide, diketopiperazine, and phenylalanine. However, at pHs above 4 only diketopiperazine was detected and the amount formed increased with increasing pH. The method developed also proved to be accurate in measuring the amount of aspartame in various food.

#Third Award - General Motors ISEF

#THE USE OF COBALT(III) OCTAHEDRAL COMPLEXES IN CERAMIC GLAZES FOR THE ACHIEVEMENT OF A VARIETY OF SPECTRAL COLORS

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A wide variety of colors is available in high fire ceramic glazes, but these colors are usually obtained through the use of two or more metal ions as colorants, and the colors are not always consistent. In an effort to develop high fire glazes of a variety of reproducible colors, and use only one metal ion colorant, cobalt(III) octahedral compounds were used. Because of the d-orbitals' structure and the resulting splitting pattern in octahedral complexes, a variety of colors, which are the result of the splitting fields caused by the ligands present, can be obtained.

To demonstrate the wide variety of colors characteristic of cobalt(III) octahedral complexes, six such compounds were synthesized in the laboratory, and others were purchased to augment the selection. Using a Bausch and Lomb Spectronic 20 Spectrophotometer, a visible spectrum was run on an aqueous solution of the nonlabile compounds. Each compound was then formulated into a $\Delta 4$ glaze consisting of 59% Gertsley Borate, 35% flint, 15% English China Clay, and .5% of a cobalt compound as colorant. A white stoneware tile was dipped in each glaze, then fired to 1186°C. in an Amaco AH10 kiln.

The fired glazes were all varying intensities of blue with the intensity of the shade generally proportional to the % Co in each compound. It was concluded that the compounds decomposed at the extremely high temperature in the kiln, freeing the cobalt to react with the oxygen in the kiln, and other metals present in the glaze and to form various oxides which resulted in the blue colors achieved.

#Second Award - General Motors ISEF

THE ADSORPTION OF FD&C DYES FROM FOOD SAMPLES

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Improvements are needed in the methods used to isolate dyes from food, drug, and cosmetic (FD&C) samples. The goal of this project was to study some of the newer chromatography adsorbents and evaluate their potential for isolating dyes from various samples. The basic procedure used in the experiments was to combine measured amounts of adsorbent, solvent, and dye in a bottle, and allow them to reach a state of equilibrium. Then spectrophotometry was used to measure the concentration of dye remaining in solution, and the percent dye adsorbed was calculated. Twenty-five adsorbents were screened for their ability to adsorb FD&C dyes. Two adsorbents, Amberlite XAD-2 and polyvinylpyrrolidone (PVP) were found to be excellent for adsorbing typical dyes. Conditions which might affect the adsorption of dyes onto these two adsorbents were then tested. The addition of up to 40% methanol reduced the adsorption of red dye on PVP from 79 to 59 percent. Changing the solution pH from approximately one to seven reduced the adsorption of both red and yellow dyes on Amberlite XAD-2. Some preliminary tests of Amberlite XAD-2 and PVP with seven assorted samples have shown that the dyes are readily isolated from the sample matrix. Amberlite XAD-2 and PVP are very promising adsorbents for the isolation of FD&C dyes from samples of food, drugs, and cosmetics.

#EFFECT OF ULTRASOUND ON THE HYDROLYSIS OF TERT-BUTYL BROMIDE IN ACETONE MEDIA

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The purpose of this study was to analyze and determine the effects of ultrasound on the hydrolysis of 2-bromo-2-methylpropane. Acetone was used as a solvent but did not enter into the reaction. The reaction rate constant without ultrasound was compared with the rate constant using ultrasound as a catalyst. By using ultrasound, this rate constant increased 57%. Increased molecular collisions, cavitation, and local temperature increases seem to be responsible for the elevated rate constants. Bulk temperature was measured and no significant change was noted. In order for the rate constant to increase in the presence of ultrasound, the activation energy (E_a) must decrease. The E_a without ultrasound was found to be 92.3 kJ while the E_a with ultrasound was found to be 90.8 kJ. An extension of this experiment has led to the production of dielectric capacitor transducers.

#Third Award - General Motors ISEF
Honorable Mention - American Chemical Society

#SPECTRA-CHEMICAL ANALYSIS

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Spectra-Chemical Analysis is the process of producing and examining the spectrum emitted by certain chemical elements. The purpose of my project was to construct a simple spectroscope, develop a means of producing continuous and bright-line spectrums, and compare my results to documented data.

An electric arc incinerator composed of two carbon rods was constructed with easily obtainable parts. One rod contained a specific chemical to be analyzed. A high resistance element (an old toaster) was incorporated in the circuit to produce a constant current across the arc. The result was a steady light source (4000-7500Å) containing wavelength characteristics of the burned element. The resulting light then passed through a diffraction grating to form the spectrum or fingerprint of that chemical. Because different chemicals were used, different fingerprints of bright-line spectra were obtained.

To document my results, I took pictures of each spectra provided by the different chemicals. With a meterstick I made bright-line wavelength readings. With this measurement and angle of sight, I calculated the Angstrom values for each spectra and found low percentage error. Thus, showing the documented angstrom readings, the bright-lines were dimensionalized on graphs. With all expectations, I plan to analyze unknown chemical elements.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Fourth Award - General Motors ISEF

#EXTRACTION, SEPARATION AND PURIFICATION OF ANTHOCYANIN PIGMENTS FOR USE AS A NATURAL FOOD COLORANT - PHASE II

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The ultimate goal of this project is to develop a natural alternative to the coal-tar dyes currently being used in foods, cosmetics, and drugs. Anthocyanin pigments were extracted from Marechal Foch grape pomace using petroleum ether followed by methanol w/1% HCl. The pomace to solvent ratio was two kilograms to three gallons to three gallons. The red pigments which were extracted with methanol w/1% HCl were concentrated using a flash evaporator. Precipitates formed on the bottom of each of the three bottles of concentrated extract, which were filtered under suction. Using C_{18} reversed-phase TLC, this year's extract was compared with last year's extract. Column chromatography was performed on this year's extract in order to separate the components of the extract on a large scale. Because no separation occurred on the column, it was decided that the extract and the three precipitates needed to be identified. At this point, the substances have not been identified. However, the substances have been tested for solubility, sugar content, and the possibility of being phenolic compounds. Currently, a spectral study is being done on all four compounds.

From the research thus far, it can be concluded that: (1) the use of petroleum ether in extraction was beneficial to further experiments (2) this year's and last year's extract are very similar (3) there is only one component pigment left in the extract, the others have precipitated out (4) all four substances are soluble in methanol and in methanol w/1% HCl (5) all four substances are phenolic compounds and are sugars or have glycosides.

#Third Award - General Motors ISEF

DOES HOT WATER FREEZE FASTER THAN COLD WATER?

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The problem of this project was to find out if hot water freezes faster than cold water. Also, the explanation of the reasons for it occuring were sought. The following hypotheses on the subject were tested:

1. Dissolved Gas Theory- It is believed that dissolved gas delays cooling. More dissolved gas is present in cold water than in warm, so the warm water will freeze faster.
2. Circulation Theory- Hot water circulates better than cold water. The hot water in the central region will move to the walls or top surface of the container more quickly. Here it will freeze faster.
3. Evaporation Theory- The warmer water will lose more of its mass and heat to evaporation. Since there is less mass to cool, the warmer water will freeze faster.

The results were positive in that hot water does freeze faster than cold water. Also, positive results were obtained for the tests involving the Dissolved Gas and Evaporation Theories. The data collected from the Circulation Theory experiments were so inconsistent that the results proved to be negative.

The conclusion reached based on the results is that hot water freezes faster than cold water. However, it only freezes faster at initial temperatures above 70°C. Dissolved gas has a slight affect on the freezing rate (to an extent of 2 or 3 degrees). The most important factor in the freezing rate was found to be evaporation.

COMPUTER SCIENCE

#DEVELOPMENT AND IMPLEMENTATION OF A SIMULATION LANGUAGE FOR 6502 BASED MICROCOMPUTERS

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The purpose of this study is to develop a simulation language that will operate in a microcomputer environment. Currently, a language known as ESP (for Efficient Simulation Programming) is being developed by this researcher to operate on an Apple //e microcomputer. This interpreter will allow for simulation programming in a manner much like that found on large mainframes using languages such as SLAM and GPSS V. In developing the ESP language a hybrid has been formed taking the most desired features of several languages and molding them into one. Currently, several simulations are running under ESP v2.1 and all show a high degree of accuracy and reliability while losing little in regard to execution time compared to mainframe based languages. This programming language provides for the reduction of mainframe expenditures and allows users of small computers to run simulation type programs, thus allowing the microcomputer user to run his or her business more efficiently.

#Fourth Award - General Motors ISEF
Honorable Mention - Upsilon Pi Epsilon, the National Computer Science Honor Society

#ROBOTIC VISION AND PATTERN DETECTION

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The purpose of this project is to develop and evaluate a Robotic Vision and Pattern Detection system. Robotic vision, and pattern detection, as currently implemented by industry, is too expensive and inefficient for use in the majority of applications areas today. This system, consisting of a Commodore 64, a MicronEYE "bullet" camera, and software, may be used as a turnkey system in those areas where vision could be used if the cost were less. A description of the project reveals those qualities necessary for a realistically useful system. First, the camera provides a binary image at up to 256 X 128 resoultion and the scan speed is sufficient for real-time applications. Secondly, the software developed gives such information as an object's location, size, and area. In conclusion, design goals for a useful, inexpensive vision system for either real or experimental applications were fufilled.

Some of the many applications for this system include:
1) LANDSAT counting for agriculture and mineral location.
2) Military equipment and troop count from reconnaissance photographs.
3) Astronomical star charting and classification.

#Third Award - Ball Electronic Systems Division
Third Award - General Motors ISEF

#CURVE TRACKING; A COMPUTER ALGORITHM FOR THE REPRESENTATION ON A CARTESIAN PLANE OF ANY TWO-VARIABLE EQUATION WHICH YIELDS A CONTINUOUS CURVE

Ton, Khoa T.H., Lowell H.S., San Francisco, CA 94132; 283 Marietta Drive, San Francisco, CA 94127.

The purpose of my project was to introduce and test an algorithm, a systematic process by which a task is attempted, which enables a computer to graph equations on the x-y plane. This new algorithm, I believe, is superior to existing graphing routines in that it is a universal one; it could graph any continuous curve in x and y and is not restricted to solely functions of one variable.

The procedure for my project is as follows: I first design the algorithm, proved the characteristics of continuous curves which are to be utilized, then coded it. The finished program was given equations which yielded ellipses, spirals, cusps, and intersecting branches, in addition to many other indescript curves to visuallize. The results of the above tests were affirmative. Curve Tracking was able to swiftly and correctly plot all continuous curves indiscriminately. My conclusion is that Curve Tracking is truly a general computer graphing algorithm which is capable of plotting any curve on the Cartesian Plane within any interval on which that curve is continuous.

The algorithm was created in Microsoft BASIC on an Apple Macintosh computer, although it could have been implemented on any computer in any language that has mathematical and dot plotting capabilities.

#First Award - IEEE Computer Society

THE DEVELOPMENT OF A DATA COMPRESSION ALGORITHM

Neef, Derick E., South Lakes H.S., Reston, VA 22091; 11527 Links Drive, Reston, VA 22090.

A data compression algorithm was developed that challenges the storage efficiency of techniques that are in use today, and provides several additional features. The algorithm is based on the principle that each different string of characters can be represented by a unique number. This allows manipulation of the data in its compressed form, thereby eliminating the potential of introducing errors during decompression and recompression. Linear Delimiters and Multiple Branching Delimiters were developed as techniques to broaden the utility of the algorithm. The combination of the algorithm and these delimitation techniques provides a very complex data encryption system, rendering a coded string that may be impossible to decode without the proper knowledge.

#First Award - United States Air Force
First Award - United States Army
Second Award - General Motors ISEF
Second Award - National Aeronautics and Space Administration

WATER SYSTEMS

Isabelle, Jonathan M., Emily Gray Jr. H.S., Tucson, AZ 85748;
900 N. Camino Cordon, Tucson, AZ 85748

The problem was to use the knowledge gained from classwork and home study to develop a computer program that could successfully teach the concepts of water systems.

I hypothesized that to provide a successful learning experience the material should be presented in an interesting manner and include self tests. In order to maintain student interest the program should be simple and easy to use.

The easier to use a program is, the more complex the programming has to be. Because of that, in comparison to the material presented, the listing had to contain a lot of instructions. Computers don't think the way people think. They can't interpret. Everything has to be logical and orderly, so I had to divide each problem into separate problems. An example of this is how I made the geysers spout and have both visual and sound effects. First I put in the sound tables, then plotted the visual on one screen and then redid it on another for the animation. Then I called the sound tables while the visual was happening. That sort of complexity needed about a thousand line listing for the subject matter. This subject matter is divided into three parts. Each section contains a material presentation, graphic illustration, and a self test. A summary and conclusion give the option of restarting the program for restudy.

The working computer program presents material in an interesting, amusing, and reinforcing way, so that it is fun for the user and results in a successful learning experience.

#MICROCOMPUTER ISOLATION AND RECOGNITION OF SPEECH PHONEMES

Clifton, William D., Neosho H.S., Neosho, MO 64850;
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Every word in the English language is composed of phonological sounds called phonemes. The purpose of this study was to interface and program a microcomputer so that it would be capable of isolating and recognizing speech phonemes in an isolated utterance.

The computer was interfaced to a microphone and amplifier through a schmitt trigger. This allowed the zero crossing rate to be calculated and the frequency for each wave determined. These frequency values were then matched against speaker-dependent stored frequency values for each of the voiced phonemes. Only voiced phonemes were used because it was difficult to distinguish many of the unvoiced phonemes from background noise because of their lower intensity and more random frequency patterns. The closest match in the comparison was reported as the phoneme that was recognized.

Phonemes were also isolated in an utterance using a predefined pattern. The utterance had to conform to a pattern of three phonemes, the middle being a particular vowel sound, and the first and last being a voiced consonant. This program first isolated the vowel sound, and the other two sounds were isolated based on the vowel sound and its duration.

#Third Award - General Motors ISEF
Alternate to Scholarship - Ohio State University
Honorable Mention - American Speech-Language-Hearing Association

THE DEVELOPMENT AND APPLICATION OF A COMPUTERIZED WEIGHING SYSTEM

Schmidt, Mark R., Walkersville H.S., Walkersville, MD 21793;
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In some forms of research, it is necessary to have a system capable of weighing a given number of animals at the push of a button, to save the data onto a storage device, and then to be able to recall that information so that it can be analysed and/or printed at another point in time.

A computerized weighing system can be built to automatically input and save data, as well as to analyze and hardcopy the data if the computer and balance have a means of connecting for data transmission.

The equipment used in this project are an IBM Personal Computer system, a Sartorius MP7/2 balance, an Epson MX-80 printer and an interface for the balance. The interface connects the data output (pin 2) from the balance to the data input (pin 3) on the IBM. This is activated by a print key which shorts pins 8 and 15 on the balance.

This system will input a weight from a balance at the touch of a button and automatically save that information onto a disk. The program will also allow the printing and analyzing of data for later examination.

The analysis subroutine includes the calculation of the mean, range, and standard deviation, as well as the total weight of a batch of items. The lowest and highest weight values may also be displayed. The user may catalog a given disk drive and delete files that he deems necessary.

This project conforms to many of the needs of a research scientist and allows him to capture, analyze, and hardcopy data from a balance with greater ease and efficiency in a programming language that is easy to understand and modify.

MENDELEVIA

De La Cruz, Angel, Clinton Central H.S., Clinton, NY 13323
99 Campus Rd., Clinton, NY 13323

The purpose of my program is to teach people of any reasonable age the basic information about the elements. Through the computer, this is achieved in a fun, simple manner. Many programs today claim to be educational programs that are fun to use. I have tried a few of these programs and have come to the conclusion that my idea of "fun while learning" does not coincide with that of most educational software programmers. I decided that I would incorporate my own idea into a program. Knowing from experience that it is not fun to sit down and immerse yourself in a book trying to memorize the names, symbols, atomic weights, and atomic numbers of the elements, I decided that this was ideal to computerize. I think that I have achieved my own idea of fun while learning in this program. Maybe the whole idea of what I mean is incorporated in the fact that many programmers call their programs "educational programs" while I call my program an "educational game". The basic game design includes score, shields, mountains, ship, scanner. The basic educational design includes the elements with the basic information about them. Both the game and educational part include much more, but this has to be seen, or played. The basic game idea is a "shoot'em up", the type everyone enjoys. In essence, the program is just a small part of a bigger picture which includes the future use of computers to study everything, to do everything.

#Summer Scholarship - Ohio State University

#SPAR: AN EXPERIMENT IN ROBOTICS AND ARTIFICIAL INTELLIGENCE

Senn, Jeffrey, Winona Sr. High, Winona, MN 55987
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There has been a controversy as to whether or not computers and robots have the ability to learn. This project is an attempt to show that machine learning can be demonstrated.

A system of learning requires two components. It requires a body, for action and feedback, and a brain, for control and response. In this project the body consisted of a robot that was built with electric motors for motion and touch switches to sense the environment. An Apple computer, programmed in Applesoft, was used as the "brain," and circuitry, designed to allow the computer to control the robot, connected robot to computer.

Programming consisted of three routines. The first, although it did not show learning, provided a base to create the latter two routines. This first, a random response routine, showed a constant efficiency of 20%. This represents a 20% probability of making a correct response to an environmental situation. The other two routines showed the ability to learn. They start at only 20% efficiency, but as they gather data the efficiency rises until it levels out at about 80%.

Although a certain extent of learning was demonstrated, improvements can be made. In the future data generalization and other routines will be written in an attempt to upgrade the learning process.

#COMPUTER SPEECH RECOGNITION

Cawthorne, Alfred B., North Quincy H.S., North Quincy, MA 02171
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Computers may provide the means for the hearing impaired to detect and interpret visually the world of sound. Since human speech is variable, attempts to recognize speech require vast memory and long processing time. The trend in industry seems to be toward literal speech recognizers used in dictation and remote control. The hearing impaired need fast, low cost speech recognizers which will put them in touch with the hearing world.

The technique used here is to interface a speech synthesis chip with a computer to get a standardized phonetic pattern. A machine language program in a second computer analyzes the wave form of the synthesized phoneme. The number of and distance between zero crossings is determined and stored in memory. A recognition program matches new synthesized phonemes with patterns in the memory. When a match is found, the corresponding letter is printed on the screen. Human speech is passed through an analog filter system, which simplifies the wave form by blocking out most of the harmonics. The resulting wave form is similar to the synthesized wave form. Using the recognition program, spoken phonemes can now be graphed on the screen.

An analog to digital conversion circuit which will input the signal directly into memory location, resulting in faster input time and greater accuracy, is presently being tested.

At first, the processed phonetic language may be difficult to understand. However, given practice, the language should become more familiar to the hearing impaired. Eventually, the low cost device will become portable using an LCD screen and solar power.

#First Award - United States Navy/Office of Naval Research

ARTIFICIAL INTELLIGENCE: LOGIC OF THE MIND

Bollacker, Kurt., Lexington H.S., Lexington, SC 29072;
134 Seases Circle., Lexington, SC 29072.

This project was an attempt to create an artificial intelligence algorithm using BASIC as the programming language. A program was developed to accept a typed English sentence with a very limited vocabulary and analyze it. The computer then applied the information analyzed to the purpose of moving graphics objects on the display screen. The computer was taught how to "learn" by asking the user what an unfamiliar phrase meant. It could then use that phrase as an integral part of the program. The program was designed to simulate a small fraction of human reasoning. Basic human thought processes were reduced to logic rules which the computer was shown to "understand". It was shown that the computer could interpret a rigidly formatted sentence with a high degree of accuracy.

ASSEMBLY LANGUAGE ON THE 6502

Brian Steward, Northwestern High School, Mellette, SD 57461
HCR 1 Box 81, Chelsea, SD 57465

In this project, I have attempted to demonstrate how Assembly language can be used to make a simple game. I call this game GONP. I have also made a flowchart showing the subroutines of this program and how they are interconnected.

The program, GONP, started out as a vague idea, that I first tried to diagram in some simple flowcharts. After sorting out my ideas, I started programming each subroutine into the computer. I used the Micromon assembler to program GONP on the PET computer. After a cycle of programming, debugging, programming, and debugging, I had a working program. I then added and deleted various routines to improve upon my work.

Through this project, I have learned how to organize a large scale Assembly program on a 6502 based computer. I have discovered that the subroutines of this program could be used in other programs by changing minor components of them. Assembly is a very versatile language. It can be used for many applications.

SOFTWARE ACTIVATED MACHINE INTELLIGENCE (S.A.M.I.)

Mason, John Paul, Kempsville H.S., Virginia Beach, VA 23464
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How do people learn? Can computers be programmed to "think?" Research on artificial intelligence was started during the 1950's but has only recently been revived after being abandoned for approximately a decade because of the emphasis on computer games. The purpose of this project was to develop and to test a theory for progressive artificial intelligence work using microcomputers. The hypothesis was that thought is a complex algorithm which can be applied and worked in computers. Using VIC-20, TRS-80, and Atari 1200 XL computers, a basic theory was developed, an appropriate computer language was designed, and the theory was tested, revised, and retested. A new programming language, new artificial intelligence theory, and classification for intelligent behavior and learning resulted from this project. The hypothesis that thought is an algorithm was supported. However, thought is a special kind of algorithm, a differential algorithm. It was concluded that artificial intelligence is possible, and the programs developed as a result of this project have been implemented. The key components of the theory for artificial intelligence are the new operational definitions for learning and thought. Follow-up experimentation was designed and performed to test the applicability and predictability of the new theory.

#A COMPUTERIZED TRANSPORTATION SYSTEM FOR THE HANDICAPPED

Marqués, Javier E., Marista H. S., Guaynabo, Puerto Rico 00657
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My project consists in the design, development, and demonstration of a computer-controlled transportation system for handicapped people visiting a museum complex. Utilizing the built-in timer of my computer and making use of the Joystick ports of the computer, I created an original software program with instruction sequences controlling the duration of electrical supply to two separate circuits: a circuit controlling the movements of a vehicle in its rails and a circuit controlling a tape recorder. The users of my system of transportation can choose from a computer menu to visit any of three museums within the complex. Once the choice is made, a poke command activates the tape recorder and a message is heard orienting the user as to the transportation system and the museum complex he is visiting. At the end of the recorded message, a poke instruction activates the vehicle circuit for a specific period of time that will allow one complete turn around the museum complex and will bring the vehicle to a stop at the museum that the user has chosen to visit. For purposes of demonstration a TCR rail system was used. A car, representing the transportation vehicle for the handicapped, has also been programed to make a demonstration run stopping at each museum if the "Demo" alternative of the menu is selected. Even though many other applications can be given to this transportation system, I have chosen a use related to the handicapped, as they appear to me to be in greatest need of such help at a time when architectural barriers are still a big problem to them.

#Fourth Award - General Motors ISEF

COMPUTER APPLICATIONS USING SOME GRAPHS AND THEIR FUNCTIONAL FORMS

Guitarte, Andrew Martino C., Ateneo de Manila Univ., Philippines
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This research is undertaken to discuss the applicability of mathematical models utilising computer applications on several scientific phenomena. These models are defined by some graphs and their functional forms. An enhanced understanding of these functions was obtained through computer applications.

Almost every scientific phenomenon can be expressed in some mathematical equations in the form $y=f(x)$. The complexity of representing too many variables in an equation was simplified.

The following functions were considered as they are applied in the following areas: Exponential function, $y=ae^{bx}$ in economics, especially in connection with growth problems, and in the biological processes involving exponential decay; Modified exponential function, $y=ab^{\frac{1}{x}}$ in data related to interest rates and in the relation of population to time; Natural growth function, $y=a(1-e^{-bx})$ in electricity exhibiting growth of current in an R-L series; Quadratic function, $y=a+bx+cx^2$ in physical phenomena involving acceleration, height, and velocity in relation to time; and Allometric function, $y=ax^b$ in the biological sciences relating diameter and weight, and pulse rates with height of persons.

Examples were discussed and illustrated. Through illustrations, a considerable amount of analysis yielded meaningful and manageable results. These results confirmed the theoretical validity of the assumptions cited by the works of authors considered in the study.

Using Apple II Plus 64K and Hewlett-Packard 9845B microcomputers reference and simulation runs, respectively, were generated. This was undertaken as a conclusive step of the research.

#EXPERIMENTAL PROGRAMMING INSTRUCTION CODE

Smith, Daniel S., Farragut H.S., Farragut, IA 51639;
Route 2, Farragut, IA 51639.

Experimental Programming Instruction Code, abbreviated as EPIC, is a new programming language for the Apple IIe. It uses the Applesoft BASIC language to interpret the EPIC program lines into something the computer can understand. It has many advantages over BASIC, like automatic line numbering. It has a more organized screen format divided into eight columns, each having its own function. EPIC uses its own DOS (Disk Operating System) and an expandable memory of 500 lines or about 20,000 characters. It implements a unique set of commands, a few of which are taken directly from BASIC and Machine Language. An excellent error detection system makes it impossible to make a mistake when typing in a command. Each command has several variations. Adding new commands is relatively simple, so the user may add new commands as needed. I am constantly expanding EPIC and someday I hope to see it as widespread as BASIC.

EPIC is a language designed for the BASIC programmer to replace BASIC. I began by designing a syntax of the language on paper and experimenting with it until it had no problems. Then I designed a program to input and run the program lines. I added more and more commands until I have what I have today. I still enter new commands into the system whenever I get a new idea. EPIC is a good language for the beginner or the BASIC programmer. It has more commands and variations than BASIC and is easier to use. I think EPIC is now a true programming language.

#Fourth Award - General Motors ISEF

A COMPARISON OF COMPUTER SORT AND SEARCH ALGORITHMS

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The purpose of this investigation was to research the most common sorts and searches and test their time efficiencies. Predictions of sort times were made by using derived equations. The following eight sorts were timed: Bubblesort, Bubblesort2, Insertionsort, Insertionsort2, Prop.Placesort, Quicksort, Selectsort, and Shellsort. The arrays had perfect, reverse, and random arrangements and had 65, 130, or 260 entries. Four searches were tested: Adjacent-Swap, Binary, Front-Swap, and Sequential. They were timed on searching for 130 alphabetic and random entries from an array. After this, the data for the sorts were plotted on a graph and predictor equations were made.

Sorts were ranked as follows (fastest to slowest): Quicksort, Shellsort, Insertionsort2, Insertionsort, Bubblesort2, Prop.Placesort, Selectsort, and Bubblesort. The searches' rankings were (fastest to slowest): Binary, Sequential, Adjacent-Swap, and Front-Swap. The predictor equations were accurate to within 30 seconds when dealing with more than 100 data entries. The times on the three different computers used (Apple //e, IBM PC, and Apple Macintosh) resulted in different actual times but the same relative speeds between the routines.

#A THREE-YEAR STUDY OF COMPUTERIZED DIFFERENTIAL IDENTIFICATION USING THE DENTAL CONFIGURATIONS AND BITEMARKS OF HOMO SAPIENS

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Because fingerprints cannot always be used to identify individuals, modern science and technology is now looking at the teeth to provide a new means of differential identification that will be a more permanent record of an individual's identity. The purpose of this research is to develop an inexpensive and reproducable computerized system which utilizes the dental bitemarks of an individual for differential identification. A bite wafer was developed to register an individual's bitemarks and the bitemarks of 183 test subjects from elementary schools were taken. A computer program was then written to convert the bitemarks into numerical values which are used to identify unknown or missing persons. A comparison of the differences in the bitemarks of the test subjects after one year demonstrated the uniqueness and validity of these values as differentiating characteristics. Because of the uniqueness and relative accuracy of this system, several identification agencies and professionals in the field of forensic dentistry have expressed an interest in the system.

#First Award - Allegheny International
First Award - General Motors ISEF
First Award - Glenn T. Seaborg Nobel Prize Visit Award
First Award - Sigma Xi, the Scientific Research Society
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Second Award - United States Air Force
Honorable Mention - Association for Computing Machinery

CELLULAR AUTOMATA

Blackman, Mark, Hobbs High School, 800 N. Jefferson, Hobbs NM 88240
504 E. Texas, Hobbs NM 88240

The objective of my project was to determine whether or not cellular automata are capable of simulating physical systems. A cellular automaton is a concept that in theory is capable of simulating physical systems. The name is derived from the fact that an automaton is a device which is programmed and they are, also the cellular refers to the concept of the cell which is pivotal to the entire concept.

My procedure consisted of designing and coding some inter-related programs for a computer, written in BASIC and machine language, to do the work of a cellular automaton. After this I began to observe dynamic runs of these programs, from this I observed the characteristics of various types of automatons and varying rules and their ongoing evolutionary processes.

In theory, cellular automata should be capable of simulating physical systems both by laws of this universe and are flexible enough to create the environment of hypothetical universe. My results indicated that patterns were evident in many but not all runs. These patterns did resemble many types of physical systems, such as weather systems developing. Other types of physical systems possible might be the development of galaxies, snowflakes, biological cells, and many diverse things.

My conclusion is that with greater degrees of sophistication it would be possible to simulate many types of physical systems.

#X-LISP: AN EXPANSION LIST PROCESSOR

Fraley, Christopher Lee, Wilson Senior High, Reading, PA 19609
1753 York Road, Reading, PA 19610

The purpose of this project is to illustrate how LISP, the popular artificial intelligence language, may be adapted to personal computers and parallel processing. Conventional LISP systems use a recursion stack in order to operate. When a function recurses, all local variables are pushed onto this stack before the function is evaluated. X-LISP (eXpansion LISt Processor) avoids the use of a recursion stack by evaluating expressions using an in-line substitution technique. The major advantage of this technique is its efficient use of memory; such conservation is important in personal computers. X-LISP runs on any 64K Apple with at least one disk drive.

A second version of X-LISP was written to experiment with parallel processing. This version, M-LISP (Multi-processing expansion LISP), uses a 68008 board in addition to the 6502 found in the Apple. Thus, during the execution of specific functions, both processors are working on independent but related tasks.

I also wrote an operating system named LANSYS (LANguage operating SYStem). LANSYS includes a full-screen editor to edit LISP functions and a fast, memory efficient disk operating system to load and save LISP programs.

#Second Award - United States Army
Third Award - General Motors ISEF
Third Award - IEEE Computer Society
Honorable Mention - Upsilon Pi Epsilon, the National Computer Science Honor Society

COMPUTER APPLICATIONS

Daigle, Brian K., East ST. John H.S., Reserve, La. 70084;
721 Madewood Dr., Laplace, La. 70068

Problem, "How can a computer be applied to the world?". My observations in trying to solve this problem have been by meeting people and finding the needs and wants of their environment.

I have found that the people just getting started in computers have wants that are not feasible for a computer's operation. Whereas people that are knowledgeable about computers, understand the computers limitations, and they ask about programs that will help alleviate their problems of everyday life.

My hypothesis from my observations of talking to people, is that I have noticed beginners are appreciative with almost all types of computer software. Intermediate computer enthusiasts are appreciative of most software but tend to go into more specific categories of software. The advanced computer enthusiasts are very specific in what they want for their software to do for them.

I have concluded that peoples' needs and wants are always changing, so the applications of a computer are always changing. You also have to take in account the computers limitations. Everyday, computers are becoming more sophisticated. When the computer can do more, the people always want more. So the applications of a computer can be unlimited. I do, however, have five main categories in which I will exhibit running programs. They are Education, Business, Recreation, Utility and Emergency Help.

A STUDY OF THE PERIODIC TABLE

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In the course of completing an assignment for my computer class, my chemistry teacher asked me to solve the problem of writing a program to cover the periodic table. He wanted it covered entirely and completely with nothing left out. I began to write a program that eventually became lengthy and too large for the computer's memory.

That left one alternative: I would have to write an individual program for each individual element, group, or series. I still needed a way to lead from program to program without having to do it manually. After extensive research, I found the commands to accomplish the goal.

After the district science fair, I began to complete my work on the periodic table. The disk filled up. There was no more memory on the disk. The solution I came up with was to connect two disk drives to the computer. Now the computer loads programs from one of two disks as needed.

The result of my labor is this project: a system of more than 125 programs all working together to form one educational program.

COMPUTERS AND SOCIETY

Mullen, Casey., Russellville H.S., Russellville, KY 42276
Route 6, Box 125, Russellville, KY 42276

The purpose of my project was to show some ways that computers are used in society. Several computer programs were written to demonstrate a few of the computer's uses. They are as follows:

1. A word processor written in BASIC and machine language.
2. A filing system written in BASIC and machine language.
3. A transformational geometry tutor program in BASIC.
4. A soil test analyzer written in BASIC.
5. A population simulation written in BASIC.
6. A shopping list aid written in BASIC.

All of the programs are original and were written by me. I plan to expand the project, adding new features and programs, in the near future.

#TEACHING SIGN LANGUAGE WITH A COMPUTER

Cheryl Leigh Rackley, Oxford, H.S., Oxford, MS 38655
Post Office Box 4886, University, MS 38677

How can the computer help the handicapped in this computer age? Computers can help the handicapped in many ways. The computer can teach sign language to a newly deaf person who can read. To use the computer to teach sign language, the computer has to be programmed with all twenty-six letters of the sign language alphabet. The programmer then has to program the computer to demonstrate these twenty-six letters or symbols of the sign language alphabet to a deaf person. After the program is written and debugged, the program is then tested. This testing has proved that a computer can be used to teach a deaf person sign language. In this way the computer has helped the handicapped in this computer age.

#First Award - Upsilon Pi Epsilon, the National Computer Science Honor Society

#IBM'S VM/CMS ON A MICROCOMPUTER

Hauser, Jeff M., Von Steuben Metro Sci Cntr, Chicago, Il 60625; 6214 N Avers Ave., Chicago, IL 60659.

Many people who have utilized mainframe computers in their careers are now buying microcomputers for personal use. Microcomputers use a different operating system and different commands. These individuals must learn the new system in order to write programs or do word processing on their new machines. To ease the transition, I have developed a series of programs that will enable microcomputers to respond to mainframe methods.

The procedure used was:

1. Define clearly the differences between micros and mainframes.
2. Decide how an instruction that works on a mainframe could be meaningful to a micro.
3. Decide what language to use for writing the programs.
4. Write a series of programs that intercept mainframe type instructions and convert them into equivalent micro instructions.
5. Have people try the programs and then note when problems arise.
6. Solve the problems that are reported to me.
7. Apply the system to the local science fair for further testing.

It is possible to write a mainframe system for a microcomputer enabling a person who has used only mainframes to adjust to a micro with a minimal amount of preparation. The user first has to learn how to power-up the machine and how to place disks in it. Later, he has to learn how to initialize disks for the system.

#First Award - National Aeronautics and Space Administration
Fourth Award - General Motors ISEF

ROBOT LANGUAGE COMPILER

Bryant, Alan D., A&M Consolidated H.S., College Station, TX 77840; 600 Guernsey, College Station, TX 77840.

The Heathkit Hero 1 robot may be programmed in two languages, standard 6800 Machine Language or Heathkit's Robot Language. In the Robot Language, the robot understands and runs 6800 Machine Language as it does normally. However, several of the undefined codes on the 6800 are defined in Robot Language. These codes move motors, operate the speech board, enable and disable senses, etc.

The major problems with writing programs to control the robot are compiling the programs to machine codes and typing these codes into the robot. This process is tedious and prone to errors. In order to allow programs to be written, compiled, and debugged at a greater speed, I have written three programs on a TRS-80 Model III. The first is a line editor; the other two are compilers.

The first step in compiling a Robot Language/Assembly Language program is writing it on the line editor. After this is done, the text is saved on a disk and the first compiler, ROBOTP1, is run. It removes all of the symbols, defines them, and replaces them with the numbers they represent. When it is finished, it makes two files on the disk, one a symbol table and the other the half-compiled text. The second program, ROBOTP2, takes the text generated by the first and finishes compiling it. It builds a source listing and a hexadecimal dump of the program. These files and the symbol table can be merged on the editor and printed.

#APCOL - A PRIMARILY COMMUNICATIONS ORIENTED LANGUAGE

Blocksome, William L., Hartselle H.S., Hartselle, AL 35640
123 Mountain View Circle, Hartselle, AL 35640

The purpose of my project is to develop a computer language that allows the writing of specialized communications applications. This language (APCOL) allows ease and versatility in programming a computer to input, process, and output information through an RS-232 port.

The steps to developing a program in APCOL are as follows: 1) define the problem, 2) design the program to solve that problem, 3) write the program following APCOL's syntactical rules with a word processor, text editor, or APCOL's built-in program editor. 4) compile the program with APCOL, and 5) execute the program.

Some features of APCOL are as follows: character variables may contain up to 255 characters, numeric variables may contain numbers up to 65535, it is a structured language without line numbers, each function within an APCOL program is defined as a section with its own section name, it compiles up to 113 times faster and executes up to 8.7 times faster than Basic.

APCOL can be used by instructors to teach students about custom communications programming, by scientists needing a way to communicate with external experiment control devices, by an astronomer needing to manipulate data received from a radio telescope, or a multitude of other things if programmed properly.

I wrote APCOL using 8080 machine code so that it can be transported to any other standard CP/M system with only minor changes. I developed APCOL on an Eagle , using an Osborne I as a remote communications computer.

#First Award - Association for Computing Machinery
Second Award - General Motors ISEF

THE USE OF INTERMEDIATE LANGUAGE IN PROGRAMMED INTERPRETERS

Oppermann, Charles W., Hernando H.S., Brooksville, Fl 33512
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The purpose of this project is to define and control the interpretation of the BASIC (Beginners All-purpose Symbolic Instruction Code) language, by designing a new, more versatile interpreter. The interpreter uses a two-level approached to parsing and executing high-level language program. A control program which is executed by the Interpreter, tells it how to parse the BASIC program. It forms a "link" between the machine language interpreter and the high-level language program.

The materials used in this project were a home-built computer, with 4 kilobytes (4K) of user memory. This computer executes the user and control programs. Another computer, a Radio Shack Color Computer developed the Interpreter code, and also serves as an Assembler for the Intermediate language program's compling symbolic statements into machine-readable code.

The result of the research provided an Interpreter with the ability to switch control programs to change with the user needs. The entire Interpreter fits in under 2K, which is 14K less than the Interpreter in the Color Computer, a 66% improvement. The control program to Interpret or BASIC language program fits in under 1K of user memory.

RANDOM NUMBER GENERATION ON COMPUTERS

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The purpose of this experiment was to measure and compare randomness in the random number generators of various computers. Seven computers were tested: Apple //e, Franklin Ace 1000, Apple MacIntosh, Commodore 64, IBM PCjr, VAX 11/750, and DEC-10. Three tests were used to determine randomness: a basic theoretical test, an advanced theoretical test, and an applied test. The first test measured binary randomness; in other words, it checked to determine whether or not half of the random numbers were above the average of the limits and half below. The second, called the Yule test, checked for a Gaussian distribution about the average through the use of the Chi-squared test. The final test was that of computing Pi from random numbers. It relied on the fact that four times the number of random points in a quarter of a unit circle divided by the number of points also falling in a unit square should equal Pi. By rating each computer from first to last for each test and by giving greatest weight to the more sophisticated tests, each computer could be ranked according to the randomness of its RNG in comparison with the others. The best pseudo-random number generator was found to be that of the DEC-10, followed, in order, by the VAX 11/750, the Apple //e, the MacIntosh, the Commodore 64, the Franklin Ace, and the IBM PCjr. Most of the test results were fairly close, which seems to indicate that it is relatively easy to make a fairly good pseudo-RNG, but quite difficult to make an extremely good one for a computer. In other words, a plateau is reached beyond which it becomes uneconomical to improve the performance of the random number generator significantly.

COMPUTER SIMULATION OF A BETA-CLASS ROBOT

Ferguson II, R. Bruce,
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If future robots are to become mobile, computer guidance programs must be written to prevent the robot from bumping into objects within a room by rapidly learning how to move around the room objects. Currently, three different robot classes of guidance programs have been developed. These can be designated Alpha, Beta, and Gamma-Class robots. Instead of comparing one class of guidance robots with another, the purpose of this project was to determine if the complexity of the room environment of the robot significantly effects the efficiency of the learning curve of a Beta-Class robot. This project performs a computer simulation of the robot's movement in a fixed size simulated room containing a varying number of random obstacles (between 10 to 90 obstacles). Through the use of 1) a collision detection routine, 2) current room location, and 3) memory of past collisions, the simulated robot determines the direction and magnitude of its next movement. A scoring routine determines the number of steps taken without collision and the number of collisions. A score of good steps/collisions was determined for each run of the robot through the simulated obstacle room. Ten robot runs were done at each level of room complexity and the scores averaged for each complexity level. From an analysis of the average scores plotted against the number of obstacles, the conclusion was that the complexity of the room does not effect the efficiency of the learning curve of a simulated Beta-Class robot.

#IMAGE PROCESSING: PICTORIAL INFORMATION AND RECOGNITION SYSTEMS

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The purpose of this project was to construct a system that can recognize and identify different shapes. This homemade imaging system was constructed in two main parts: the camera and the computer program. The camera was built using six phototransistors, amplifiers, and inverter buffers. It was constructed so that when an image is rotated on a small plexiglass platform it passes over the phototransistors. When light hits a phototransistor, it allows current to flow through the amplifier pulling the input of the inverter buffer low and causing the computer to detect a one at the output of the buffer. When the light is blocked by the shape, the computer detects a zero. After the codes are stored in memory, the program analyzes the information. Through the steps of operation, analysis, and interpretation, the computer recognizes the test image by template matching (comparing the codes of the test image to the codes stored in memory), resulting in an average accuracy of 90%.

#Second Award - National Aeronautics and Space Administration
Fourth Award - General Motors ISEF
Honorable Mention - Society of Photographic Scientists and Engineers

PROGRAMS FOR THE TRS-80 COLOR COMPUTER

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During the last few years the microcomputer demands have grown up to incredible levels. To supply this demand, the computers companies are trying to make powerful computers with lower prices and beautiful looks. One of these new computers is to TRS-80 color computer. So, I will try to prove the unlimited potential of the microcomputer in the 80's. I use a set of game programs prepared by me to prove my objective.

As examples of my work with computers, I can present some games, such as:

1. Popeye
2. Sunround
3. Moonpatrol in Standard Basic
4. Night Patrol in Extended Basic

I am ready to discuss the objectives, techniques and methods used and the difficulties met while working in the project.

ELECTRONIC VOICE DIGITATION: A NEW APPROACH

Ervin, Thomas C., Sidney Lanier H.S., Montgomery, AL;
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Electronic voice digitation is the digital electronic technique involved in artificially reproducing sounds interpreted by the human ear as speech. Incorporating speech into computer software, though, usually means investing a lot of time and money in hardware, software, and possible memory expansion. These problems are very common.

In my project, though, I have developed an assembly language computer program with the addition of simple hardware to provide for an economical and effecient means of voice digitation, storage, and retrieval.

ANALITIC GEOMETRY TUTOR PROGRAM

Meléndez Hernández, Israel, De La Salle College, Riverview, Bayamón, Puerto Rico

6 St. #23, Tintillo Gardens, Guaynabo, Puerto Rico 00657

This computer tutor program is design to let any student learn the basic concepts of geometric forms known as conic sections. It depies graphically how these figures develop and lets you know which rules have to be met in order to form the correct shape. Furthermore, it gives other valuable information like: the different type of cone shapes, its parts, defenitions, how to identify and find the surface, the number of focal points, etc.

It also demonstrates how to recognize conic shapes in the Universe and the Earth using examples which are very easy to visualize. The program also contains biografic abstracts about the early mathematicians, founders of this science, who dedicated themselves to the study of conical shapes.

This computer program was developed with the purpose of explaining a very important topic of geometry, making emphazis on how to develop a graph of a conic section looks, how it is form, and other information concerning the study of this geometric form.

EARTH AND SPACE SCIENCES

THE MOTION OF THE OCEAN:
THE STUDY OF THE WAVES ON THE SHORELINE

Levin, Rebecca A., Choctawhatchee H.S., Ft. Walton Beach, FL 32548; 7 Poplar Ave., Shalimar, FL 32579.

I have been working on this project for three years. The first year , I took pictures of models of different types of jetties and sea walls using a wave generator and an overhead projector. I showed how the jetties and sea walls reflect waves. Last year, I took more pictures and did further research into beach erosion in Florida and the rest of the United States. This year, I researched different types of beach protection and factors, such as sediment transport and the littoral drift, I also devised a new experiment for showing how a beach erodes and the ramificationsof stopping erosion. On my backboard, I have my experiment pictures, some local problems and some suggested solutions. I have also illustrated the different parts of a wave, how waves move and some different types of shoreline protection.

"GEOTECTONICS AND GLOBAL LITHOSPHERIC DYNAMICS"

De Leon, Ramon
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1722 North Hermitage Avenue, Chicago, Illinois 60622

The purpose of this investigation is to illustrate the relationships between seismic activity, volcanogenic processes, orogenesis, and lithospheric displacement.

Such relationships show that it is possible to determine the future continental configurations, and the locations of mineral deposits by their tectonic setting.

The location of various volcanic and seismic regions were plotted using coordinates on a latitudinal and longitudinal scale, and then correlated with the location of plate boundaries. In addition the location of certain mineral deposits and their tectonic settings were analyzed. This was done on a more local scale in Mexico. Utilizing paleomagnetic data, lithospheric plate spreading rates were calculated by dividing the distance from the ridge axis by corresponding age of the oceanic crust.

From the determination of the spreading rates it was possible to illustrate past continental configurations. A study of the distribution of mineral deposits suggests that they are restricted to certain tectonic settings. Global lithospheric dynamics provides a model for classifying the tectonic setting in which a mineral deposit was formed, which suggests that similar deposits can be found at an equivalent location. Utilizing the calculated spreading rates, continental configurations were extrapolated two hundred and fifty million years into the future. In addition a preliminary geologic map of the San Luis Potosi region was prepared.

#A CONTINUED INVESTIGATION OF QSO NEBULOSITY

Griffy, Charla C., New Smyrna Beach H.S., New Smyrna Beach, FL 32069;
1709 Orange Tree Dr., Edgewater, FL 32069

A CONTINUED INVESTIGATION OF QSO NEBULOSITY is an extension of a project started in 1981 and continued to the present. The former dealt with radial jets, material seeming to separate from the nucleus of QSO's at unthinkable and relativistically impossible speeds. However, an explanation of this phenomena was found and again QSO nebulosity was the topic of examination (in 1982), as the plausibility of regarding seemingly compact companions of QSO's as remnant cores of galaxies that have interacted with the QSO's was tested. This question was resolved and with the purpose of answering some of the remaining questions regarding QSO nebulosity and the connection between QSO's and galaxies, the present investigation was set up.

Through research and the comparison of nuclear and nebular spectra of QSO's included in a selected sample, the nature of the emitting region (morphology of extended material) and possibly the relationship between the luminosity function of the underlying galaxy to the luminosity of the QSO nuclei was hoped to be found. By research, analyzation, and comparison of the obtained nuclear and nebulosity spectra, evidence was found which seemed strongly indicative that most of the selected QSO's are found in galaxies (having in their immediate vicinity underlying galaxies) which evidence indicates, are spiral and have young stellar populations.

#First Award - Bushnell Division of Bausch & Lomb
First Award - National Aeronautics and Space Administration
Third Award - General Motors ISEF

THE JUPITER EFFECT PHASE II: CLIMATOLOGY & DENDROCHRONOLOGY

Kulman, Eva June, Grants High School, Grants, NM 87020
445 Aspen, Grants, NM 87020

Does Jupiter have enough gravitational force to effect the sun thus, influencing the atmosphere on Earth? The elliptical orbit of Jupiter causes fluctuations in gravitational forces. The greatest and least are the perihelion and aphelion. Jupiter's perihelion, closest point to the sun, is based upon a 10-12 year interval.

Sunspot activity is also found to follow an 11 year cycle. Evidence supports that sunspots increase and decrease in intervals, completing a 22 year cycle. If there is a correlation between sunspot activity and Earth's weather, it would be best observed in precipitation.

Another method of studying long-term weather patterns in Dendrochronology, tree-ring dating. Since the amount of precipitation in a given region would affect the growth of trees, tree-rings of selected trees were studied. The tree-rings were counted, measured, and the averages of each of the rings were graphed. In order to demonstrate that widths of ring-growth correlates to man's own recordings of climate, climatic charts were gathered. The recording stations chosen, were the nearest to where the trees were grown. These charts of measured rainfall were graphed and compared to ring-width graphs.

It was determined that there is a correlation between precipitation and tree-ring widths. The recording station was within a distance of 200 yards to the selected tree area. The other recording station and tree area were 8 miles apart; there was minimal correlation. When the recording station is within a minimal distance to the tree area, a positive correlation was visible.

FOUR METHODS OF EXCAVATION IN AN INVESTIGATION OF THE WILSON POTTERY

Sagebiel, Kerry, Rockdale High School, Rockdale, TX 76567;
1708 Alcoa, Rockdale, TX 76567

PURPOSE: To discover the remains of the pug mill
To prove the mound south of the sherd pile is the kiln
To learn about pottery
To discover artifacts

PROCEDURE: Four methods were used:
Pit Method: Used on the sherd pile. A pit was dug with trowels and by hand because of the high concentration of pottery.
Trench Method: A trench was dug on a line of sand and ash on the suspected kiln mound. Heavy shovels were used because of compacted ash and heavy accumulation of bobs.
Grid Method: After covering the vicinity of the pug mill with a metal detector and flagging each artifact, a grid was laid with string and stakes. The area under each flag was excavated.
Surface Excavation: Carefully scanning the ground for artifacts on the surface.
Artifacts discovered by the four methods were sketched in situ and/or photographed.

RESULTS: The pug mill was not found intact, but many pieces of metal pertaining to it were found. I found definite evidence the mound is the kiln. Many rare and significant artifacts were discovered in the kiln and sherd pile.

CONCLUSIONS: The mound south of the sherd pile is the kiln. The pug mill stood in the area east of the sherd pile.

REFLECTIONS: This site is an important one in the history of Central Texas. Studying early Texas potteries helps us to understand more about how pioneers coped with the disadvantages of living where quality goods were scarce.

#Honorable Mention - Eastman Kodak Company

THE DESIGN, CONSTRUCTION AND EFFICIENCY ANALYSIS OF A SIMULATED SOLAR GEL POND

Yim, David, Upper Dublin H.S., Fort Washington, PA 19034;
669 Meadowbrook Ave., Ambler, PA 19002

Because our Earth's fossil fuel supply is rapidly diminishing, solar energy must now be put to good use. In order to effectively utilize the two billionths of the sun's entire output, efficient and inexpensive methods of harnessing this light and heat that comes from the sun must be developed.

The purpose of this project was to design and construct a solar gel pond, using sand and an ethylene glycol-based substance (antifreeze) to store the heat that was captured, and to test its heat-retaining ability.

After doing some library research, a hypothesis was developed stating that the solar gel pond that was described above would be able to hold solar heat in an efficient and inexpensive way.

The researcher then proceeded to construct his gel pond and to collect data for five days by placing the gel pond and a control pond in sunlight and recording the temperatures of:

A. Room or air; B. Water (control); C. Oil (top layer of gel pond used to prevent evaporation); D. Antifreeze top; E. Antifreeze bottom; F. Sand

at 7 A.M., 3 P.M., 5 P.M., 7 P.M., and 9 P.M. The experiment was then repeated using an infrared red heat lamp, and a 230-watt incandescent light bulb.

After analyzing the data, the experimenter concludes that the solar gel pond that was tested for heat-retaining ability can efficiently be used to aid a home hot water heating system.

#Fourth Award - General Motors ISEF

#CONDENSATION NUCLEATION: A STUDY OF pH FACTORS AFFECTING SNOW CRYSTAL FORMATION

Phillips, Tom, Oakton High School, Vienna, Va. 22180
13100 Laneview Ct., Herndon, Va. 22071

The purpose of my research project was to determine the affect of pH on the threshold temperature at which snow crystals nucleate.
Hypothesis I: The pH of the water content of a snow crystal will affect the temperature at which it nucleates.
Hypothesis II: An acidic pH level will allow the snow crystal to nucleate at a warmer temperature.
Hypothesis III: An alkaline pH level will allow the snow crystal to nucleate at a colder temperature.
A chamber was used to grow artificial snow crystals using calcium carbonate, calcium chloride, gypsum, hematite, and volcanic ash as nuclei. Water with pH levels ranging from 4.0 to 9.0 was heated to the boiling point, introduced into the chamber, and allowed to condense. Five experiments were conducted for each of the compounds, at each of the pH levels that were tested, for a total of 100 experiments. Threshold temperatures of snow crystal formation were recorded, and the snow crystals were microscopically analyzed and photographed. The pH of the water content of the snow crystal caused the compounds to nucleate at different temperatures. Both the acidic and alkaline pH levels caused the snow crystals to nucleate at warmer temperatures than the neutral pH level.

#First Award - American Meteorological Society
First Award - United States Navy/Office of Naval Research
Second Award - General Motors ISEF
Alternate to London International Youth Science Fortnight - United States Marine Corps

MICROFOSSIL SHAPE ANALYSIS USING LASER SHADOW CONTOURING

Somerville, Rachel, Gompers Secondary School, San Diego, Ca.
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The purpose of this project is to discover a method of quantifying the contours of a microfossil in three dimensions. Ultimately, this information is to be used in conjunction with other methods of shape analysis in applications dealing with soft-rock petroleum geology.

The method which was developed uses the trigonometric relationship between the distortion of a straight shadow cast on an object and the elevation of the object at that point. It was necessary to use a laser and a system of lenses and columnating devices for the light source in order to minimize error caused by diffraction.

Computer software was written to construct a complete contour map of a fossil from the elevation data obtained through the above process. From the contour information, it was possible to make certain relevent morphological calculations about the fossil, such as the relationship of successive chamber volumes, degree of whorl spiraling, and the grouping tendencies of measured chamber angles. These calculations were performed on several species of foraminifera. It would then be possible to draw conclusions of taxonomical, evolutionary, biostratigraphical, and paleoenvironmental significance from these calculations using existing methods.

#First Award - American Association of Petroleum Geologists
First Award - Association of Women Geoscientists Foundation
First Award - General Motors ISEF
Scholarship - United States Navy
London International Youth Science Fortnight - United States Navy
Second Award - Sigma Xi, the Scientific Research Society
Alternate Award - Society of Exploration Geophysicists

THE STATIC FACTOR

Devine, Bob M., Fairfax H.S., Fairfax, MN 55332
701 S. Park St., Fairfax, MN 55332

The purpose of my project was to compare existing theories on rain to a more recent one, involving the use of static electricity. Through my experiments I found that this particular theory involving the use of static was better suited to explaining the phenomena of rain. From this I formed the hypothesis that the static electricity present in clouds was a major reason for rain formation.

The procedure I followed to prove this new theory was to induce an electrical charge into a vapor and observe the result. I used a Van de Graf generator to produce the static charge and administered it through two wires, one at the base and one at the top, into the vapor while a spark jumped between the two wires. I also used some bacteria as a natural nuclei for my vapor. To compare the condensation ability of a non-charged nuclei to a charged nuclei I passed the first bacteria sample through pre-charged air and the second sample through non-charged air.

What I observed and the conclusion I came to was that the presence of a static charge in the cloud itself was vital to the formation of precipitation of any sort, although I did not find the exact part played by static in rain formation, I did conclude that static had an unquestionable part to play in the rain forming process.

#STUDY OF THE SOLAR ACTIVITY AND THE RELATIONSHIP BETWEEN SOLAR FLARES AND SUNSPOTS

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Barrio Cocos, Bz. C-212-1, Quebradillas, P.R. 00742

My investigation theme is the study of the solar activity, limiting myself to only two aspects of it. The prime object is to search a direct relation between the different properties of the sunspots groups and the flares number. According to my hypothesis I consider that there exist a numeric relationship between both phenomena. To prove the relation I used data supplied by the solar observatory at Ramey Base, Aguadilla. With that information I made some correlation graphs and another statistical analysis to demonstrate, if the physical complexity, magnetic complexity and distribution have a relation with the number of flares in a group. Once the results were obtained we can observe that the correlation coefficient is low but can sustain a clear relation because this kind of phenomena is very unexpected. Also, I found that exits a strong relationship between the magnetic complexity and the number of flares that were produced. The second part of my investigation consisted in trying to determine the relationship between the area of the group like a factor in the probability of the group to produces flares and in the intensity of them. For that purpose I made some correlation graphs, multiple regressions analysis and histograms with a microcomputer that help me found a relationship. I determined that there exist tendencies in the groups with more area to have more probabilities to produce flares than a group with less area. Also the area is a good indicator of the intensity of the flare.

#Second Award - United States Air Force

DETERMINATION OF ABSOLUTE MAGNITUDES THROUGH PHOTOGRAPHIC IMAGE DIAMETERS, PRINT CALIBRATION, AND APPARENT MAGNITUDES

Claussen, Craig A., Kouts H.S., Kouts, IN 46347
718 Elizabeth St., Kouts, IN 46347

The objective of the first part of this project was the determination of the apparent magnitudes of randomly selected stars on a print. The first step was to photograph each of the areas around selected major stars. Next, the images of selected stars in each field, including the known star, were measured and their diameters in millimeters were recorded. I then designed a formula and a computer program to determine the magnitudes of the selected stars. The formula is $m' = (m \times d)/d'$, where m and m' are the magnitudes of the known and unknown stars respectively, and d and d' are the diameters of the images of the known and unknown stars, respectively. Next, three graphs were drawn to find the relationship between the magnitudes and diameters. On the first graph, the diameters are plotted as abscissae and the magnitudes are plotted as ordinates. On the second graph, the abscissae are the principal square roots of the diameters, and on the third graph, they are the common logarithms of the diameters. Programs were designed for these calculations. The graph with the straightest line to fit the points is selected, and the line connecting the points is drawn. This line of calibration may be used to find magnitudes of other stars.

The next part of this project dealt with finding the absolute magnitudes of stars. The formula for finding this is $M = m + 5 + 5(\log p'')$, where M is the absolute magnitude, m is the apparent magnitude, and p'' is the star's parallax in arcseconds. I practiced graphical techniques to verify my findings and used them to graph new knowledge.

#RIVER DISCHARGE MEASUREMENTS WITH AN AIR BUBBLE DEVICE

Dann, Mary Ann, Lake Weir H.S., Candler,FL 32624
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Models are developed to describe the gross behavior of air bubble plumes generated by point and line sources of air bubble released in water bodies of uniform density. The models predict plume velocities and induced flow rates as a function of elevation form the source.

Experimentation with the air bubble device occurred as a direct problem to the question, how does someone obtain a feasible velocity reading in a vegetated water course without the use of a propeller type turbine. The answer to this question may lie in the evaluation of a potential hydroelectric site, using the air bubble device.

Three problems will be addressed when evaluating a potential site; where the location of hydroelectric site may be found, if a dam is constructed how many people will you flood out of homes and how far down river, also what effect will the site have on the reservoir?

Testing was done in selected hydroelectric sites, with the air bubble device to determine velocity flows. It was found that amoung the rivers tested, they resulted in very low amounts of hydroelectric output, due to very low velocities.

This research was done to develop a significant role for the use of the air bubble device in vegetated water ways of Florida's rivers and springs.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
First Award - United States Army
Third Award - Association of Women Geoscientists Foundation
Fourth Award - American Association of Petroleum Geologists
Honorable Mention - American Meteorological Society

#CHEMICAL STORAGE OF SOLAR ENERGY

Eastes, Wayne, Roy High School, Roy, Utah 84067
3928 So. 3650 W., Roy, Utah 84067

An important component of a solar-collection device is the storage of solar energy. This could be done through conventional methods using stone, water, or Glauber's salt which range in efficiency from 20 to 40 percent. However, I have designed and built a model of a storage device which uses the heat of solution of sodium hydroxide to store solar energy. The device uses an exothermic chemical reaction, heat of solution, which occurs when water is added to sodium hydroxide. One advantage this type of device has over other devices is that the energy can be stored indefinitely without any loss of energy. My experiments were run on a comparison basis, comparing the storage capabilities of stone, water, and Glauber's salt to my device using the heat of solution of sodium hydroxide. Using the heat of solution of sodium hydroxide has proven to be 35 percent more efficient than conventional storage materials. This device can maintain a high level of efficiency over indefinite periods of time.

Some major advantages to this type of solar storage device are: The mass needed in conventional storage devices is not needed. This is because the heat energy is stored in the chemical bonds of Sodium Hydroxide, thus making it smaller and less expensive. Another advantage is no heat energy is lost through convection. Because the heat is stored in chemical bonds it can be kept at any temperature and still retain the same amount of energy.

#First Award - United States Air Force
Fourth Award - General Motors ISEF

#"SNOW CORNICES"

Culler, Timothy, Taos Junior High School, P.O. Box 1338, Taos NM 87571
P.O. Box 442, Questa NM 87556

Snow cornices are a leading cause of avalanches, and pose danger to winter sports such as skiing, but nothing is known about the way in which they form.

The initial hypothesis is that snow cornices form by mechanical aggregation, not by chemical bonding. Observing a natural cornice forming supported this hypothesis, as the points of the lacy six-armed flakes seemed to tangle onto each other and stay there.

Wind tunnel experiments with sand, salt and snow showed that only snow could form cornices. Sand and salt both formed dunes. If chemical bonding were responsible salt should form better cornices than snow because snow uses hydrogen bonds, while salt uses stronger ionic bonds.

Angle of repose experiments showed that most particles larger than 1.5 mm in diameter had angles of repose from 30 to 35°. Extremely small particles had higher angles of repose. The exception to this rule is snow, which had an angle of repose greater than 90° no matter what the particle size.

All of these experiments seemed to support the hypothesis. The conclusion is therefore that snow does indeed form cornices through mechanical entanglement.

This project will make winter sports areas safer because more will be known about cornice growth, and avalanche warnings may be issued when cornices are forming.

#Second Award - United States Army
Honorable Mention - Eastman Kodak Company

#THE SALINITY OF THE GREAT SALT LAKE

Wente, Todd J., Davis High School, Kaysville, UT 84037
249 South Edgehill Drive, Fruit Heights, UT 84037

My experiment was concerned with The Great Salt Lake, more specifically with the changing salinity of this lake. I had decided that a logical sequence for salinity change would be that as the depth increased, the salinity would do the same. To prove my hypothesis I had to take water samples from different depths, evaporate the water, and weigh the remaining salts. I acquired the water samples by using a home-made extraction apparatus and evaporated the water by using an oven. This first sampling took place on December 24, 1984. I transferred the salt into plastic dishes and weighed them, both with and without salt. I then obtained a direct salt measurement by subtracting the weight of the dishes from the weight of the salt and dishes combined. My second sampling took place on April 6th, 1985. I again used the apparatus and obtained measurements, however, this time I weighed the salt while in the collecting jar and later the jar itself. I then compared the measurements to obtain a salt weight.

On the first sampling, erratic and peculiar changes were present. This led me to believe that a thermocline exists within the lake at approximately 6 feet. The second measurements showed a more gradual change and fewer peculiar readings. It is my understanding that a thermocline "disappears" during the spring and fall and a gradual change of salinity, temperature, and density results. This would seem to support my theory, but we were unable to take temperature readings because of lack of equipment and money.

#Fifth Award - American Association of Petroleum Geologists

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#TESTING THE EFFICIENCY OF GROINS COMPARED TO BREAKWATERS IN THE PREVENTION OF SHORELINE EROSION

Williams, Chris, Upper Dublin H.S., Fort Washington, PA 19034; 122 Apel Ave., Oreland, PA 19075

The problem in my experiment is: Will a breakwater constructed of stone rubble work better than a groin constructed of stone rubble in the prevention of shoreline erosion?

I feel that if a stone groin is compared to a stone breakwater for 48 hours, then the stone breakwater will prove to be more efficient for preventing shoreline erosion.

In order to do this, a wave tank will have to be constructed along with an apparatus for generating waves. A breakwater and a groin constructed of stone along with a control have to each be run for 48 hours. From the measurements taken on sand depth, water line and water depth, a conclusion then has to be made.

After collecting and analyzing my data, I was able to conclude that the hypothesis was correct and this means that breakwaters are a better method of shoreline protection when compared to groins.

In each experiment, the beach was left basically the same except for a greater beach length and deeper sand depths at certain points when experimenting with the breakwater.

In my experiment, I ran into a problem with the simulation of long-shore drift which is an important factor involved in shore building.

For future experimentation, I would like to test other types of erosion control methods.

#Second Award - Marine Technology Society/U.S. Naval Institute
Third Award - American Association of Petroleum Geologists

ENGINEERING

A ROBOT FOR THE HOME

Sant, David J., Catholic Central H.S.,Redford Mich.48239: 29587 Puritan, Livonia Mich. 48154.

The purpose of this project is to design and build a computer controlled robot that can be used in a home environment to do simple tasks.

After months of designing the robot I began to construct its frame out of aluminum angle iron. Once this was complete I cut the outer panels out of regular aluminum siding and bent them to the correct shapes.

The next step was to wire the robot's twelve motors, relays, sensors, switches, and display indicators. Once this was complete I proceeded to interface the robot to a Timex Sinclear 1000 computer.

The next, and final, step was to design programs that can be run on the robot's computer that will allow the robot to function independately. The programs allow the robot to move around and use its single arm to pick up objects and place them back down.

In conclusion I found that it was possible to design and build a computer controlled robot that can be used in a home environment to do simple tasks.

THE FLIGHT OF THE PAPER AIRPLANE.

Forbes, Collin W., Moscow Junior High School, Moscow, ID 83843; 937 N. Grant St., Moscow, ID 83843.

This project tested the performance of three designs of paper airplanes using seven papers of different weights and finishes. The hypothesis is that the flight depends on the design, wing area and the weight of the paper.

Six airplanes of each design were launched three times from a seated position at the uppermost central row of seats in the constant environment of a domed stadium. Flights were timed and landings recorded by section, row, seat, aisle, track or field. Calculations of distance using the Pythagorean Theorem were adjusted for the slope of the stadium.

The flat-V design flew a greater distance than either the dart or delta designs, with averages of 13.9, 10.6, and 4.8 meters, respectively. Parchment flat-V airplanes flew the longest average distance at 19.2 meters. The longest individual flight was by a parchment flat-V at 48.9 meters. The flat-V design had the longest average flight time and the least wing area. The dart design flew at the fastest average speed, 3.68 m/sec. The laid finish 20 lb paper dart flew an average distance of 16.8 meters. A delta onionskin airplane flew for 24 seconds. Wing area was greatest for deltas, and related to slowest speeds.

Distance flown was not different due to the weight of the paper, but flight time was greatest with least paper weight. Speed was greatest with the heaviest paper.

Gravity over the sloping seating sections increased the distances considerably. These flights outdistanced those in Scientific American's 1967 paper airplane contest for similar designs.

#DEVELOPMENT AND TESTING OF OPTIMIZED ROCKET DESIGNS

Gesner, Michael W., Cardinal Spellman H.S., Brockton, MA 02402
95 East Main Street, Avon, MA 02322

The goal of this research was to develop a design process for single-stage model rockets which are optimized from the standpoint of altitude capability. To achieve this, I interpreted results from aerodynamic research to find the means to reduce drag, an aerodynamic force which resists motion and decreases altitude capability.

I translated this process into a BASIC computer program which was then used to design a vehicle which would be powered by a specific type of engine. Software of my own development was then used to analyze the engine's buring characteristics, and to control an engine test stand which would verify this analysis. Additional programs were then written to analyze the vehicle's stability and drag properties. I then constructed the vehicle and subjected it to wind tunnel testing to verify the analyses, and use the results to contruct a flight performance profile for the vehicle. Flight testing was then conducted to verify the performance profile for the vehicle. Flight testing was then conducted to verify the performance predictions. The initial aim of this project, to develop a set of rules to design high performance model rockets was thus achieved. A secondary result of my work was development of the means to analyze the vehicle's flight performance, and to test these analyses.

#First Award - National Aeronautics and Space Administration

#CAN AN APPLE COMPUTER RECOGNIZE SPEECH?

Chuang, Isaac, Ballard H.S., Louisville, Ky. 40222;
8309 Star Point Ct., Prospect, Ky. 40059.

Today some of the most complex processing involves the recognition of speech. This project is designed to determine if an Apple Computer can process and recognize speech. The hardware added is a data conversion and signal forming interface. Speech through a microphone is converted by an ADC817 to digital data, which is sampled by the Apple. Output for testing is through a DAC801 and a LM386 amplifier. The speech is sampled at about 10 Khz, stored in a buffer, bandpass filtered, then energy processed. The templates formed are 32x8 or 64x4, and are compared by using a Dynamic-Time Warping algorithm. The entire software interface is in 6502 machine language for maximum speed. The evaluation criteria are speed of recognition, percentage of error in recognition, maximum number of words possible, and a subjective rating between 1 and 10, representing no recognition and perfect recognition. It was found that the Apple took between 15 and 30 seconds for processing, and could not clearly distinguish between more than five words. However, there may be errors in the algorithms and the programs. Therefore, on a sunbective scale, the Apple ranks about a five, putting it on the level of a data entry system that is speaker independent.

#First Award - Acoustical Society of America
Second Award - IEEE Computer Society
Third Award - General Motors ISEF

PPO II (PERSISTANCE PAYS OFF): A STUDY IN ROBOTICS

Meck, Michael A., Herth Mariem H. S., Farmington, W.V. 26571
Rt. 2, Box 182, Fairmont, W.V. 26554

The goal of my research was to design and construct a functional robot with its own onboard computer. PPO II (Persistance Pays Off; version # 2) is controlled by a Z-80 based computer which I designed and built. The computer presently contains 4K of Static RAM and 8K of EPROM. It has nine I/O ports which connect the computer to external robotic sensors and motors. The 8255A-5's which provide these ports also tie the computer to the hexadecimal keyboard and 7-segment displays. The onboard computer gets programs from the hexidecimal keyboard and can also load programs form the Commodore Vic-20. By using the Commodore computer I can save programs on cassette and then use them later. The onboard computer guides the robot through various maneuvers. The robot can be programmed to perform other maneuvers. A future application for the robot is security related. It could function as a security guard in the home or industry. With the addition of a radio link, the robot could alert a computer tied to the phone which could alert the police of an intrusion.

The present robot is very limited in its application but it meets my original goals. After achieving my original goal, I began designing more peripherals for the robot. Although most of the new peripherals are still on the drawing board, they will give the robot greater flexibility in the future. My future plans include an interpreter which will allow the use of more human commands.

#First Award - General Motors ISEF

#Computer Controlled Robotic Arm

Worland, Michael A.,Southview H. S.. Sylvania, OH 43560
3252 McCord Rd., Toledo, OH 43615

Handroid II is a computer controlled robotic arm that is capable of performing tasks on its own. It has a feedback system which allows the computer to determine the position of each joint on the arm as well as the presence and relative density of objects within the hand. Handroid is connected to the computer by means of an interface which allows the computer to control the arm's movements. With the computer controlling it, the arm can do a wide range of tasks.

The arm has a series of geared motors which allow it to move in almost any direction. There are five motors, one at each joint. These motors run on low voltage, low amperage, direct current which is easy to supply. The feedback system has one potentiometer at each joint and a phototransistor in the hand. The potentiometers provide the computer with data that reflects the position of the joints and helps to determine further movements. The phototransistor provides data regarding the presence and relative density of objects within the hand. The interface (which allows the computer to control the arm's movements) has six relays, one for each motor in the arm and one that controls the polarity of the power source. With the computer controlling the arm and the arm providing constant feedback, the system is accurate, flexible, reliable, and capable of performing a wide variety of functions.

#First Award - Allegheny International

ANALYZING RUTHERFORD BACKSCATTERING (RBS) SPECTRA FORMED WITH LITHIUM IONS

Anderson, Mark E., Davenport Central H.S., Davenport, IA 52803; 3018 E. 18th St., Davenport, IA 52803.

The Rutherford Backscattering Spectrometry (RBS) technique uses an ion beam to analyze the depth profile and concentrations of elements in the top few microns of a sample. This research involves the type of ion used in the ion beam. Helium is the most commonly used ion, but this research shows that high-energy lithium ions are more effective for the RBS technique.

The ion beam is generated in a Van de Graaf linear accelerator and directed to the sample. A small fraction of the ions in the beam (perhaps one in a million) are repelled by the positively-charged nucleus of an atom in the sample and lose a certain amount of energy characterictic to the mass of that nucleus. A computer then tallies the energy loss data. An existing computer program helped to analyze this energy loss data, but it included unnecessary nuclear reaction calculations which prolonged running time. In addition, the program couldn't analyze Li ion beam data. Phase I of my research involved rewriting the program in order to:

1) Provide simplification and faster execution; and
2) Handle data gained using Li ions.

Phase II involved the Li ion testing. Experiments show that spectra formed by the program with high-energy Li ion data are much more clearly defined than high- or low-energy He spectra. Therefore, it can be concluded that high-energy Li ion beams give more useful RBS data than He ion beams.

AERODYNAMICS-"IN SEARCH OF THE OPTIMUM DESIGN"

Nichols, Kent D., Salem Sr. H., Salem, MO 65560; Rt. 1 Box 191a, Salem MO 65560

The researcher has spent over four years, and near 600 hours of research in the past year, in the development of a new subsonic jet aircraft design. The designing process of the new aircraft design, the NK-708a, began in the spring of 1984. The requirements of the new aircraft design were set forth by the designer. A thorough study of these requirements followed. References were made to other research conducted in the past that related to the designer's own design. Preliminary and baseline configurational development followed. The resultant was an aircraft design and many calculations. From here further development followed. Various components of the design were tested, changes were made, and eventually after hundreds of hours of work, an aircraft design resulted. This new aircraft satisfied the requirements very closely. The designer designed and built a windtunnel model of the new design. Through the cooperation of Dr. Robert Oetting and the University of Missouri-Rolla, the designer conducted windtunnel testing of the NK-708a design. A wealth of data was gathered. With this data the designer improved the design even further. A final configuration resulted. For actual flight testing of the design a radio control prototype aircraft was scheduled for future design testing. Structural designing of the prototype followed. By March of 1985 an aircraft design had emerged from much time and experimentation which fulfilled all of the design requirements. The time and effort invested proved to be priceless to the designer who had gained the new knowledge.

#Fourth Award - General Motors ISEF

ZEROTH: A STUDY IN ROBOTIC DESIGN

Reid, David E., East Mecklenburg H.S., Charlotte, N.C. 28212; 6800 Folger Dr., Charlotte, N.C. 28226

By experimenting with different designs and approaches, I hope to broaden my knowledge of robotics. The purpose of my project is to improve the efficiency of my robot through the study and application of the various designs. Specifically, my current research has centered around the mechanics of the functioning arms.

During the last seven years I have built several robots. Each time I build another robot, I try to improve and develop it's abilities. The latest product of my ongoing experiment with robotics is Zeroth. He has fifteen servomotors and two cylinders that operate his functions. One of these functions is Zeroth's ability to pick up small objects and place them in any one or more of the three dimensions. He also has the ability to move over most terrain and to "see" where he is going via C.C.T.V. He is remot- and radio-controlled and has some interchangealbe parts.

As one can see, Zeroth is not as sophisticated as industrial robots. This is partly due to a lack of tools, knowledge, and availibility of parts, but the purpose was not to build an industrial robot. My purpose was to gain a knowledge through first-hand experience in the development of a robot. I have found that trying to locate the proper materials, tools, and suitable data on robotics is a big problem in pursuing my research in the field of robotics. Also, a knowledge of engineering, mathematics, schematics, and electronics is essential. (This, of course, varies with the complexity and design).

THE SUSPENSION HOME: A POSSIBLE APPLICATION OF TENSIONAL INTEGRITY STRUCTURES

Lee, Charles O., DeRidder High School, DeRidder, LA 70634
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In the past and in the present, architects have designed buildings which employ traditional design techniques, mainly the use of continuous compression members in the main supporting framework. This type of structure has one inherent design flaw: the point of connection between compression members acts as a pivot point for collapse under situations of extreme stress.

My project views a relatively new design where no two compression members are in contact. This design is called Tensegrity: a contraction of tensional integrity. The continuity of the system is achieved by a system of tension members. These tension members allow greater flexibility while still maintaining the proper form. Also, any stress or vibration is passed equally about the frame, preventing excess stress on any single point.

To test any possible practical applications, small-scale models of Tensegrity and pin-and-girder systems were constructed. Weights were placed on the models to determine load capacity. Although the Tensegrity systems showed minor responses to load first, they withstood greater load before collapse. Tests to examine tensile strength and torque were not possible, but drop-testing is underway.

From my studies, I believe that Tensegrity systems can be applied for practical advantages. Because of greater flexibility, they could be employed in buildings to better withstand the elements and even provide housing with movable bases in areas plagued by earthquakes.

JAWS II; 8 BITS TO THE BITE

Jones, Andy, Moriarty High School, P.O.Drawer 20, Moriarty NM 87035
P.O. Box 544, Edgewood NM 87015

The purpose of my research in the field of robotics, computers, and interfaces (electronics) was to learn about past and present technology. This project consists of: an Expert Lego Building Block robotic arm, a computer interface, and a Commodore-64 computer.

The mechanical improvements to the robot included a total redesign of the arm. This increased the angular movement in five out of the six motions. The hand was miniaturized by moving the gripper motor and drive to the forearm. The base rotation gear drive was replaced by an improved chain driven pivot mechanism.

The electrical improvements were extensive. The battery was replaced by a voltage regulated power supply. The interface was upgraded to allow two or more motors and feedback to be controlled by the computer simultaneously. A feedback potentiometer on the shaft of each motion has been added to sense joint position. A teach box was constructed to allow the operator to tell the computer where to place the arm.

The computer program was upgraded to manage additional data from the feedback circuits and the teach box controller. A new Machine Language program was developed to handle the feedback and motor control data between the computer and the robotic arm.

Working in the field of robotics, computers, and electronics, a great deal of current knowledge was gained. In continuing this research, more information will be obtained for building future models.

#THE SEEING EYE ROBOT
Swain, Mark, Marysville High School, Marysville, CA. 95901
1135 Keifer Street, Marysville, CA. 95901

The purpose of my project is to design and construct a robot tool to aid the blind. I built a small robot that can lead a blind person along a black line. The line can be placed in the halls of schools, hospitals, shopping malls or other public places. The robot provides a signal that will identify its location to a blind person using a modified "bar code" on the floor.

This robot could be implemented in a hospital. Room numbers could be painted on floors with the proper bar code. This eliminates the need for a nurse to take time to lead a blind person to his or her room. With some modifications, it could be used to guide a blind person along city sidewalks.

In testing the robot I placed a long piece of black tape about 1½" wide on the floor. The robot could follow a straight or curved line. To test the bar code sensor I placed the same kind of line offset from the track, so that the photo-cell could detect the line and signal the operator to his or her location.

In conclusion, I think there is a need for this type of device to aid the blind, and that my robot will work very well for this task. Ms. Holly Bibbines, a teacher for the blind at Marysville High School stated, "This is a very interesting project, I can see that it would have many applications in public places."

#Honorable Mention - American Optometric Association

#THE DEVELOPMENT OF A ROBOTIC CONTROL SYSTEM
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The personal robots of today are basically toys. These toys are expensive and hard to program. This is because in all cases the computer is built in and is not easily accessible to the operator. In this research project a robotic control system was designed and constructed. A micro computer is used to operate the system by remote control. Serial data is sent through a modem which then changes the data to frequencies. The frequencies are then received by the modem on the robot and is changed back into serial data. A method was then designed to convert the serial data to parallel data. The 8 bits of data are then used to generate a possible forty-eight 7 bit parallel ports. These ports provide for the possibility of many added functions. For example the addition of an arm, voice synthesisor, or any other function desired. The design of this system proved to be adequate and easily provides for further additions. Complex Mechanical devices can now be controlled by the user with the advantage of a user inter active micro computer.

Using micro computer to control robots by remote control is definitely an advance in robotic control. To make this system truly superior to current methods of control two way communication will need to be established. Two way communication will be developed by reversing the process described above.

#First Award - Society of Manufacturing Engineers
Fourth Award - General Motors ISEF

PARABOLIC TROUGH COLLECTOR PHASE 3: PERFECTING THE SYSTEM

Calfee, Gary W., Burkburnett H.S., Burkburnett, TX 76354
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This is the third in a series of projects aimed first at increasing my knowledge of solar power systems and later aimed at the basics of engineered motion control systems. The first phase was to build and test a large parabolic trough collector, and the second was to add a tracking system. The result was a system that was adequate for a science fair project, but lacked in quality and mechanical design preciseness. The third phase of my project dealt with the design and development of a quality motion control system that could be implemented in a solar tracking system.

While designing the new system several aspects had to be taken into account. The mirror drive in phase two was mechanically loose. The addition of further gearing, as well as adjustable mechanisms, solved the problems of slippage. Another consideration was the basic principle of the tracking system that used an open loop system. Hewlet/Packard optical encoders were used as feedback for a closed loop control system. Hardware counter circuitry for both of the encoders was designed and interfaced to my Commodore 64 user port. A computer program then controls all tracking functions from calculating the position of the sun to driving and monitoring motors. It was concluded that a precise and efficient solar tracking system can be controlled by means of a home computer.

#HOW CAN ROCKETRY STAGING BE IMPROVED?

Rider, Todd H., Ole Main H.S., North Little Rock, AR 72116;
501 West A St., North Little Rock, AR 72116.

The goals of this project are to design and evaluate a more efficient system of rocketry staging.

In the improved design, the rocket is divided into more stages to jettison excess mass more often. For solid propellant vehicles, the engine nozzle slides upward into a pipe which melts and shortens as the fuel burns. In liquid propellant rockets, the engine slides upward through a central fuel tank as the fuel is consumed. Doughnut-shaped oxidizer tanks on the outside of the fuel tank are jettisoned when empty. This system allows the same engine to be used for the entire flight.

To test this staging method, computer flight simulations comparing the actual Pershing 1A, Titan II, and Saturn V to their "improved" versions were run, using data obtained from the Army, Air Force and NASA.

A five-stage uprated Pershing 1A was found to have 32% greater range/payload capability, or 38% less necessary launch mass than the standard missile. Similarly, a ten-stage Titan II displayed 49% greater maximum altitude, 44% greater payload capability, or 16% less launch mass. A twenty-stage Saturn V yielded 35% greater velocity, 32% greater payload capability, or 40% less launch mass.

This rocketry design appears to make such large numbers of stages feasible, and certainly justifies further research to prove its engineerability and practicality. Applications abound for both military ballistic missiles and civilian launch vehicles.

#First Award - American Astronautical Society
First Award - National Aeronautics and Space Administration
Fourth Award - General Motors ISEF

DESIGN VERSUS TRUSS OR BEAM STRENGTH

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The proper design of a truss or beam must be derived at for any structure to be constructed. The proper designed truss structure must be built efficiently, and be of durable strength. A truss is a structure of bars, in this case of Basswood, all lying in one plane and connected at their ends in such a manner as to form a rigid framework.

To obtain the most efficient and durable design of a truss, seven trusses and a beam all of Basswood were constructed to scale. The volume for each truss was then calculated. Loads were applied to the trusses to a deflection of 1.25 millimeters. The load applied to each truss was then divided into the volume of each truss. By these calculations I obtained a number of Cubic Centimeters/Kilogram, which gave me an efficiency rating for each truss. The results obtained from this experiment may assist in finding an acceptable truss design for general construction.

COMPUTERIZED ROBOT CONTROL THROUGH A REMOTE COMPUTER

Darnell, Timothy, Melvindale H. S., Melvindale MI, 48122;
14836 Russell St., Allen Park, MI., 48101.

My project was highly influenced by NASA'S progress with the space shuttle program. After researching the idea of how NASA could control the space shuttle's computers through a base computer back on earth, I finally came up with a logical idea to use for my robot. My project made the use of two computers with modems which were either linked up to a transmitter (base computer) or a receiver (robot's computer). The base computer uses pre written programs run by either a joy stick or the keyboard. After data is fed into the base computer (through either the joystick or the keyboard) it is then sent into a modem, which is used for modulating and demodulating the computer's signals for communication purposes. After the signals leave the modem they are sent into a transmitter, which changes them into radio waves, and then are received by the robot's receiver. From there they are fed into another modem, which in turn is connected to the onboard computer of the robot. A computer program (in the robot's onboard computer) then decides which decision to make. I found all the results of my research very positive and I am still amazed at how NASA does it.

Quartz Accuracy for Fendulum Clocks

Mes, John K., Bartlesville Mid - High,
Bartlesville, Oklahoma, 74006
5920 Martin Ln. B'ville, Okla., 74006

I designed and built a $35 system giving quartz accuracy to pendulum clocks. The system regulated the clock's pendulum motion by electromagnets linked to a quartz time reference. The clock fitted with such control had an accuracy to within .1 second of the quartz time reference.

DEVELOPMENT OF A PRACTICAL 6502-BASED CAD/CAM SYSTEM WITH ACTIVE PARAMETRIC CIRCUIT ANALYSIS

Miles, John C., Antlers High School, Antlers, OK 74523;
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While our present CAD/CAM (Computer-Assisted Design/Computer-Assisted Manufacturing) systems are giving truly prodiguous results to the electronic design engineer, most of the time the process merely involves using the computer and its software as nothing more than a rather complex calculating machine. The basic purpose behind my project is to give the design software a means of "active analysis", or a method of providing information to the user on the circuit's real-time operational characteristics. When this is done as part of a passive simulation in the design process, the final results from the prototype will be affected adversely by anything and everything from component tolerances to stray circuit capacitances. The software must be able to work with the interface peripherals in an analysis process directed towards allowing the computer to actually display the prototype's operational parameters under powered-up conditions, in order to realize maximum utility from a complex and expensive design network.

While this has been done to some extent in digital logic analysis, my research has been mainly oriented toward analog/linear design. Space does not permit an elaborate dissertation here, but the results so far can be described as "entirely successful". To date, I have implemented this concept in systems for the passive design and real-time analysis of a Wien-bridge notch filter circuit and a single-stage audio amplifier model. It is my theory that this approach is capable of saving thousands of dollars and hours of time by utilizing this "soft" approach to prototype testing and evaluation in a larger, more practical scale.

CAN WAVES BE FILTERED MATHEMATICALLY?

Hunckler, Laura A., Central Catholic H.S., Lafayette, IN 47905
2323 Ellen Drive, Lafayette, IN 47905

The purpose of this project was to determine whether an arbitrary wave could be mathematically broken down into sine and cosine wave components.

First, an audio signal generator, electronic filter and oscilloscope were set up in sequence to analyze the waveforms as waves are filtered. I concluded that (1) all waves are made of a fundamental sine wave and an infinite number of harmonics; and (2) these harmonics decrease in amplitude as their frequency increases.

Using the concepts of integration and Fourier Series, I wrote a computer program that acts like the electronic filter except it prints out values of the frequency and amplitude of the harmonics rather than plotting their waveforms.

Finally, I plugged the harmonics produced by the filtering program into a program I wrote last year. The harmonics were added together and then plotted on the screen, producing the original wave.

This project may be used in stress analysis. The effect of a chuckhole on a car's frame may be found by first mathematically building the car into a computer. Then, with my program, the wave produced by hitting the chuckhole may be broken down into its component sine and cosine waves. The waves are then run through the computer containing the car. The sum of effects of waves is the effect the chuckhole will produce on the car. Because this analysis may be done before the actual car is built, it saves time and money.

#Honorable Mention - Acoustical Society of America

CAP: A COMPUTER ASSISTED ELECTRONIC X-Y PLOTTER

James, Micheal, Eldorado High School, 11300 Montgomery NE, Albuquerque NM 87111
11905 St. Marys Dr. NE, Albuquerque NM 87111

One advantage that microcomputers have over mainframes is their utilization of video graphics. This advantage can be more useful if graphics can be transferred to hard copy. One method used is a plotter, which is a pen or marking instrument that is electronically moved over paper in two directions, X and Y. Because of the high price of comercially available plotters and the need to transfer graphics to hard copy, it is the purpose of this project to design and construct an inexpensive X-Y plotter that can be controlled by an Apple II microcomputer.

It was determined that for the plotter to be accurate, stepper motors must be used. To create movement in a stepper motor, four internal motor coils must be turned on and off in a specific pattern. To generate this pattern a digital logic control circuit was designed and checked by "breadboarding." Once the circuit was functioning properly, the printed circuit board was drafted on a CAD (Computer Aided Drafting) system and constructed. It included dual stepper motor drives, pen position control, limit controls, and an optoisolated Apple II game port interface. The mechanical plotter was built using ballbearing drawer guides and all-thread rods. The circuit and plotter were interfaced with the computer, and a controlling program was written.

CAP is an inexpensive X-Y plotter with a simple microcomputer interface. It has no built-in memory and depends on the host computer for all drawing instructions. It has a theoretical accuracy of 0.0010" which is limited by the mechanical accuracy.

#Fourth Award - General Motors ISEF

#DESIGNING, BUILDING, & TESTING STABILIZATION SYSTEMS FOR A HOVERCRAFT

Turnipseed, John Parker, Weir Attendance Center, Weir, MS 39772
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Stability has been a major obstacle in the development of the hovercraft. To gain optimum performance, the craft must be stable in order to lessen skirt drag, which is a primary factor in hovercraft performance.

The experimental hovercraft, constructed in stage I, was improved with innovative design modification that included: a swiveling ducted propeller to enable tighter turns, a four-bladed propeller to increase lift height, and prevent skirt drag, and a stronger simple skirt, all of which aided in the stability of the craft.

Three different types of stabilization systems were designed, built and tested. The people balance system worked by the operator's moving his weight to balance the craft. In the compartmentation method, the underside of the craft was separated into three compartments in which air pressure is increased when the craft is tilted. The skirt-shift method worked by shifting the main skirt and controlling the amount of air released.

A test course was set up to test the performance of each system. Calculations were made of the velocity and acceleration of the craft, by timing the hovercraft at different intervals along the course.

The results showed that the compartmentation method provided more stabilization than the skirt-shift or people balance methods.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
First Award - United States Navy/Office of Naval Research
Third Award - Marine Technology Society/U.S. Naval Institute

FLUIDIZED-BED COMBUSTION: A HOT IDEA

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The purposes of this experiment were to design and construct a fluidized-bed combustion unit, an elevated filtration-bed, and to test a coal-calcium carbonate mixture.

Fluidized-bed combustion is quite simple. Air is forced through a preheated bed of sand. The sand resembles undulating volcanic lava. The sand appears to have become fluidized. Its appearance lends itself to its name. The preheated sand ignites the coal and acts as a storage area for heat. This means it requires less fuel to maintain a constant temperature than conventional furnaces.

The elevated filtration-bed increased the efficiency of the system fifteen percent. It consisted of a grate, which was implanted above combustion. Upon the grate rested steel bearings (balls). This system served to filter fly ash from flue gas, decrease heat wave velocity, and to absorb heat in the same manner as the fluidized-bed.

Calcium carbonate, mixed with the coal in a two to one ratio to the sulfur content, was tested for its ability to deter sulfur dioxide formation. Sulfur dioxide is one of the products of combusting coal, and results in the formation of acid rain. Calcium carbonate, when injected into coal burning furnaces, combines with sulfur, found in the coal, to form calcium sulfate, carbon dioxide, and oxygen. In this way the sulfur is not released into the atmosphere: thus, acid rain is not formed.

Fluidized-bed combustion being more fuel efficient, and less harmful to the environment, makes it a hot idea.

#First Award - U.S. Department of Energy
Fourth Award - General Motors ISEF

IMPROVING THE AERODYNAMIC EFFICIENCY OF HUMAN-POWERED VEHICLES

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2703 Woodfern Ct., Woodbridge, VA 22192.

PURPOSE: Modern human-powered vehicles have remained relatively unchanged since the late 1800's and are extremely inefficient. At 30mph, a cyclist uses 80% of his power simply to push air out of the way. The object of this experiment was to determine which variation of a teardrop airfoil would provide the least aerodynamic drag for such an application.

RATIONALE: The drag exerted on a shape can be drastically reduced through streamlining. Teardrop shapes are used because previous research has determined that such shapes result in the smoothest airflow around the body.

RESEARCH DESIGN AND PROCEDURE: It was necessary to design and build a wind tunnel in order to test the aerodynamic efficiency of various shapes. Four models were built, varying only in the location of the shoulder (widest point). The first had its shoulder located 1 1/4 inches behind the leading edge. The shoulders of each of the other models were moved backwards 3/4 inch each time. They were mounted on the sting (mount) in the wind tunnel and tested to determine the drag exerted on each. These results were compared with those obtained from testing a 5x3x3 balsa wood block. The models were then rated on a scale of one to ten, one being the drag exerted on the mount alone and ten being that of the block.

FINDINGS: From the results obtained, it was determined that the model with the shoulder furthest forward was the most efficient. Also, as the shoulder was moved backwards, drag increased.

INTERPRETATIONS: The fact that drag increased as the shoulder was moved toward the rear infers that a teardrop shape which tapers slowly to the trailing edge is more aerodynamically efficient than one which tapers more rapidly.

#Third Award - General Motors ISEF

EXPANDED STUDIES OF X-RAYS ON INTEGRATED CIRCUITS

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The purpose of my project was to measure the damage caused by various levels of X-Ray radiation exposure to EPROMS. I chose to work with EPROMS because they are programmable integrated circuits in common use in computer and electronic devices. A library search and written contacts, indicated little or no research had been reported, concerning this topic.

I used a Fairchild Sentry Integrated Circuit Testing System, provided by a local industry, to make a base test run on each of my chips. I then seperated the chips into groups of five, on static absorbing foam, using group one as my control. I exposed my other groups to increasing dosages of X-Rays. My exposure levels were from 1 millirad to 1000 rads, encompassing 9 points of exposure. I determined the dosage in rads with a radiation level dosimeter. After exposure, I again ran a complete series of tests on all chips and collected data, to determine any change in program on the chip, as well as possible physical and/or functional damage. I carried out eighteen different parameter checks on each integrated circuit. I analyzed my data and prepared graphs showing the amount of damage done and the levels at which you could expect to show this damage.

My conclusion is, that between low and high dosage levels of X-Ray radiation, no protective measures need be taken to shield these devices. At levels, at or above, 100 rads, I detected both physical and soft programmatic damage. The information obtained through my research shows the precautions necessary to protect the devices, under practical industrial, medical and military situations.

#First Award - National Aeronautics and Space Administration
Second Award - Institute of Electrical and Electronics Engineers, Inc.

MICROCOMPUTER ACTIVATED ROBOT (MAR)

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In the first phase of this project, an ambulatory robot was designed in an effort to gain an understanding of electronics and robotics. This included a basic understanding of electronic components as well as mechanical and electrical engineering.

The purpose of phase II of this project was to engineer and build a robotic arm similar to those used in a factory situation. Keeping in mind safety in the work environment and efficiency, the arm must be both accurate and able to perform a programmed task repeatedly. To achieve this goal, potentiometers were used at each of the arm's six axes. An apple computer was used to monitor the position of the potentiometers and to control the robot. The robot was taught specific movements using a teach pendant. These movements were saved and can be played back an infinite number of times.

To demonstrate the robot, a simulated factory situation containing a master reset button (outside the work area) and a light beam around the work area, to sense an unauthorized access, were used.

Robots in today's factory may be taking jobs away from workers, but they are also saving many humans from injury. This is because most of the jobs they perform are those where the injury rate to humans is quite high. As more sophisticated robots are designed and used, more employees with technical experience will be needed to provide repair and programming. The safety of the workers in the robotic environment, though, should be the companies' primary concern.

#Second Award - General Motors ISEF

THE EFFECTS OF GEOTHERMAL BRINE ON TUBING IN A COUNTERFLOW HEAT EXCHANGE SYSTEM

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At the Hawaii Geothermal Power Plant Well-A on the Big Island of Hawaii, electricity is produced by using steam from an underground reservoir to turn a turbine. However, a great deal of excess fluid, geothermal brine, also comes from this reservoir. This fluid contains many corrosive elements such as Hydrogen-Sulfide and silica that make it unusable.

My project dealt with finding an inexpensive tubing which can be used in a counterflow heat exchange system to transfer the heat from geothermal brine to another medium so it can be used for power production purposes. The tubing must be inexpensive because a commercial scale heat transfer would require miles of tubing and special alloys would cost more than the rest of the power plant. Coils of the tubing being tested were immersed in an insulated cylinder. Geothermal brine would flow through the tubing while cold water would flow around it. Temperatures of both fluids were measured upon their entering the cylinder and upon their exit. This information was used to compute the heat coefficient of the system which indicates the efficiency of the heat transfer. By comparing day to day results, I was able to determine if the heat coefficient was decreasing and consequently if the tubing was corroding.

I tested stainless steel 316 and copper tubing. The copper became clogged in two days because it is such a reactive material. The stainless steel lasted thirty days, but it too proved incapable of surviving the environment of the brine. My project has been taken over and the search for a tubing continues.

AERODYNAMICS — THE UNSEEN SCIENCE

Bjur, Brian R., Bainbridge H.S., Bainbridge Island, WA 98110;
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The science of aerodynamics benefits us in many ways. It provides us with information on how air flows around objects and what shapes are the most efficient at accomplishing their tasks. Unfortunately, the public knows very little about this science and has little understanding of how aerodynamics aids the flow of air around an object even in its basic form.

My project explains and illustrates the principles of aerodynamics to shed light on this deserving science. I also prove the hypothesis that: Reducing the frontal area of an object is the most effective way to reduce the drag of that object. I demonstrated the principles of aerodynamics and tested my hypothesis with identically sized and weighted balsa wood models in a wind tunnel. Measuring the drag of each model with weights, I was able to find the drag of the models in grams to make more accurate comparisons. I constructed the models to test the effect of decreasing the frontal area, rounding the corners, and various tail designs. Comparing all of the decreases in drag to the drag of their original unaerodynamic wood block shapes, I determined the total reduction of each. I found that reducing the frontal area resulted in the biggest decrease in drag.

Aerodynamics benefits our cars, buildings, and airplanes, just to name a few. These benefits are in the form of more fuel-efficient, safer, and functional designs. The science of aerodynamics deserves to be understood and given credit for its accomplishments. By explaining its principles and showing the best method to improve the efficiency of vehicles and buildings, I hope to help the public understand this amazing science and how it benefits all of us.

ELECTRONIC AND COMPUTER CONTROLLED DRUMS

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The aim of the project is to allow musicians, both drummers and non-drummers alike, to produce rhythms electronically. There are three ways in which this can be done: (a) by use of an electronic drum kit, which I have constructed and is played in the same way as an acoustic kit; (b) by use of software that I have written using the computer's internal sound capabilities; and (c) by interfacing the electronic circuits used in the drum kit with the computer, allowing rhythms to be pre-programmed.

The use of the computer allows people who cannot actually play the drums to compose the exact rhythms that they require by eliminating the need to physically strike the drums. Once the rhythm has been entered into the computer, it can easily be edited and modified. The user also has complete control over the sounds produced by the computer and those created by the electronic circuits.

The electronic drum kit is intended to be played by drummers. It consists of a bass drum and seven smaller drum pads and stands. The circuits are housed in the fibre-glass bass drum moulding. The smaller drum pads have a rubberised surface, giving an acoustic drum 'feel' when struck with a drum stick. These smaller pads contain transducers which are connected to the circuits, thereby triggering them when the pad is struck.

#GRAPHITE-EPOXY COMPOSITE REPLACEMENTS FOR ENGINE COMPONENTS

Vinarcik, Michael J., St. Ignatius H.S., Cleveland, OH 44113; 7759 Edgewood Lane, Seven Hills, OH 44131

Composites are systems created by the union of a reinforcing element and a compatible binder to produce a material with specific properties and characteristics. This relatively new technology offers the possibility of creating high-strength replacements for components which once could only be made from metals. Some fields in which composites are being applied are aerospace and transportation. Another area in which composites show promise is the area of internal combustion engine components. I felt the connecting rod and wrist pin of a small gasoline engine were suitable candidates for composite replacements. Graphite and epoxy were selected as materials because of their suitability for such an application. Filament winding is the method of composite engineering utilized for producing high-strength composites, and it is this procedure which I chose to follow for my project. After suitable winding machinery and a curing oven had been designed and constructed, several connecting rods and wrist pins were produced and tested. Fully operational replacements were made after much experimentation and many design changes. Both the composite connecting rod and wrist pin were placed in the engine and functioned perfectly. The future of composites as replacements for metals looks bright, especially in the areas where metals now dominate, and they surely will play a vital role as the high-strength materials of tomorrow.

#First Award - Eastman Kodak Company
First Award - General Motors Corporation
Scholarship - Ohio State University
Third Award - Society of Manufacturing Engineers

#COMPUTER CONTROLLED SORTING GRID

Young, Bryan E., Cedar Falls H.S., Cedar Falls, IA 50613
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The computer controlled sorting grid was not a research project; it was a design project. I did this project in order to learn the engineering principles of an entire robotic project. Electrical, mechanical, and computer engineering were studied and applied.

The first part of this project involved the design and construction of a interface that would allow the input and output of digital data from the internal bus systems of a computer. The original interfacing research was done with the Timex Sinclair 1000, but for ease of software development and program storage, the Apple II computer was used for the final project.

The second area of engineering that was exercised in this project was that of mechanical engineering. This involved the design of two drive systems, two motor feedback systems and a lifting mechanism. The components that are used in the sorting grid were designed and fabricated using the school's horizontal and vertical milling machines.

The final part of the project was software engineering. This involved the development of software to examine 27 lines of input and control 14 lines of output from the sorting grid. The project, as of now, has tremendous potential to do more complicated tasks such as sorting objects by size or digitizing a drawing. These tasks could be achieved with more complex software.

As industry becomes more and more automated there is going to be a much greater need for skilled engineers to design automated systems. This project maybe simple by industry standards, but I believe it demonstrates all phases of industrial automation.

#Second Award - Society of Manufacturing Engineers

#A METHOD TO STIMULATE GEOTROPISM IN A MICRO-GRAVITY ENVIRONMENT

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In the past, a variety of experiments have been done concerning plant growth in space. The results have been poor because of the micro-gravity environment that exists in earth orbit. With the proposed space station becoming closer to being a reality, it has become more important to overcome the problem of plant growth in space. In space, there is little or no gravity to stimulate the geotropism necessary for plant life. The purpose of my project was to design and build an apparatus which would overcome this problem. The apparatus I built succeeds in doing so by rotating plants. This motion creates a centrifugal force. I found that if I regulated the velocity of my apparatus, I could create a centrifugal force equal to the force of gravity. To prove that plant life would be affected by centrifugal force the same way it is affected by gravatational force, I spent a number of months experimenting with growing different types of plants in different stages of development in my apparatus. I found, by using a control group, that the effects of centrifugal force upon plants did not differ from the effects of gravatational force. This proved that there is a comparable substitution for the force of gravity to stimulate geotropism in plants.

#Second Award - National Aeronautics and Space Administration
Third Award - General Motors ISEF

#MEMBRANES IMPROVE INSULATION EFFICIENCY

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The method of applying loose-fill insulation in household attics is a major error costing an estimated fifty-two billion dollars annually. Data collected over the last seven years demonstrates that the application of a membrane over the insulation would significantly improve the efficiency of loose-fill insulation.

This research project is the result of an attempt to compare different insulations using "K" and "R" values. It was found that the thermal conductivity constants used and accepted world wide are grossly in error. In fact, 10 inches of loose-fill insulation in an attic was found to have an "R" value of 1, not 27.

Extensive tests were also conducted to determine if moisture condensation was affected. It was determined that moisture was reduced in all tests with a protective membrane over the insulation.

A two mil polyethelene film was placed over the insulation in several attics. The utility usage was evaluated using climatological data and degree day comparisons. In all tests where conclusions could be made, there was a savings of 50 per cent or more.

Research is continuing on this project using layered membranes horizontally in the insulation. If one membrane is used over the insulation, the "R" value is increased from 1 to 10. If layered membranes are used, the "R" value is increased from 20 to 30. Tests have been conducted using a white perforated polyethelene. The white material decreases the moisture content and increases the "R" value significantly compared to the clear membrane.

Two patents are pending on this process.

#Fourth Award - Engineering
Honorable Mention - U.S. Department of Energy

AIR QUALITY CONTROL: INDOOR

Kainz, Chad, Jamestown High School, Jamestown, North Dakota
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Air quality control is rapidly becoming an important part of everyday life. With the increased pollutants in the atmosphere, air cleaning is a must.

My project deals with the engineering of improved air quality control devices. The experimentation was conducted using a High Efficienty Particulate Air filter (HEPA), FARR panel filter, and five different electronic air cleaner (EAC) designs. Being unable to modify the arrestance or efficienty of the HEPA and FARR filters, the EAC was selected for experimentation.

Three testing methods were developed; the arrestance test, comparison test and bacteria test. The arrestance test simulated actual operating conditions for an air filtering/cleaning system. The comparison test was designed primarily for the EAC's in order to demonstrate their air cleaning ability in adverse conditons. The bacteria test demonstrated the filtering ability of each filter/cleaner using living material.

Experimentation with the five EAC's showed that complete ionization of particles has a greater effect on an EAC's arrestance. Under adverse conditions, however, greater ionization area is more important than complete ionization. Overall increased collecting area will increase arrestance. Efficienty is related to the location of the ionization area with respect to the collection area. Based on this idea, the "Ionization Overlap Theory" was developed.

FLYING ON THE GROUND: SLASHING AERODYNAMIC DRAG IN AUTOMOBILES FOR GREATER EFFICIENCY

Illa, Craig W., Highland H. S., Ewing, MO 63440
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One of the key factors to obtaining greater efficiency in automobiles is the reduction of aerodynamic drag. While the use of smaller or more efficient engines and the reduction of weight accounts for some improvement, the reduction of aero-drag provices the greatest potential for improvement of efficiency. In highway driving, approximately 70% of a car's energy consumption goes into overcoming aerodynamic drag. By redesigning cars to minimize drag, it is obvious that the result would be greater fuel efficiency.

The purpose of this project was to use the concepts of aerodynamics as a tool for designing aero-efficient automobiles. Tests were first run on several basic shapes to compare the airflow patterns around the shapes and the resulting air drag. Combinations of these shapes were then tested to note any changes in drag. These results were compared to find what possible shape(s) had the least amount of air resistance. The best overall shape proved to be the airfoil (teardrop) shape. This was then incorporated into the design of automobiles with as few changes as possible to the overall structure, to assure a low coefficient of drag. Eight different automobile designs were then drawn up with clay counterparts being manufactured for testing purposes. These models were then tested to find both errors in design and overall air drag.

It was found that the slashing of air drag in automobiles is very possible, but complete redesigning is necessary for a maximum payoff. Though the art and science of automobile aerodynamics is a recent one, it is sure to receive much more attention in the very near future because of the dramatic influence it has on automotive efficiency.

SPO256 PARAMETER ACCESS FOR USER-DEFINED ALLOPHONE, FORMANT AND SYNTHESIZED SPEECH

Ouellette, Edward J., Carman H.S., Flint, MI 48504
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My project is designed to allow home computer users to define their own custom speech ROMs at a minimum cost with high efficiency. My research centered around providing parameter access for the General Instrument's SPO256 speech IC series. During my investigation, I discovered the following inherent limitations in many medium-cost, user-oriented speech systems: Many speech development systems can only be implemented on a main-frame computer or a dedicated co-processor unit. Others offer only one speech encoding scheme, while others inflict extensive charges and produce memory-hungry products, a waste for most home computers. My project deals with correcting these problems by advancing the efficiency, eliminating the restrictions and reducing the costs of a personal speech analysis/synthesis system. My speech board offers LPC, Formant and Allophone synthesis techniques, all implemented with one $10 speech IC. Users can analyze, store and synthesize their own speech in the above schemes with most personal computers, instead of waiting in line for custom GI serial speech ROMs costing $100 or more per second of LPC speech. Also, this system can be used for industrial monitoring, military codes/scramblers as well as a speech aide for vocally handicapped persons. Finally, it could open new horizons for visually handicapped persons as computer programmers and users by voice confirmation of data input.

#A STUDY AND POSSIBLE APPLICATION OF THE GROUND EFFECT

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It was hypothesized that by placing a wing in near-ground proximity, an air cushion would be formed underneath the wing which could possibly increase the aerodynamic quality. If so, then utilization of this ground effect could save millions of dollars in aircraft fuel. The first step to utilization would be to determine how and in what manner the ground effect influences the aerodynamic characteristics of an airfoil and this is what was attempted in the project.

A study of the influences of this effect and its theory was executed from previous investigations. The ground effect was found to increase the lift curve slope and reduce the induced drag, which means an increase in aerodynamic quality. In theory, the ground effect is represented by the bound and trailing vortices of an "image wing."

A wind tunnel with a 22.2 meter/second velocity was designed and constructed. From over 100 pages of blowers and fans the one that would produce the highest velocity was mathematically calculated and purchased. A pitot-static tube was used to determine velocity, extent of turbulence, separation, and boundary layer before and after the intake was in place. It was also used in the intake design so that laminar flow was achieved with the lowest possible reduction in velocity.

A Clark Y airfoil with an aspect ratio of 1 was tested in free air and at height/chords of .75, .5, and .25 from ground plates that induced normal ground effect, and the influence of the image bound and trailing vortices separately. Tests were conducted at a Reynolds' number of 86,000. Lift, drag, and static pressure were measured and compared to theoretical. The lift coefficients agreed closely with theory, but the drag coefficients contained considerable error.

#

Alternate to London International Youth Science Fortnight - United States Navy/Naval Air Systems Command

FISHSCALES FOR FLIGHT

Merrill, Mark Cutler
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328 No. 500 E., Price, Ut 84501

The intent of my research is to determine the "Fishscale Theory" validity; will scales used on conventional low speed general aviation airfoils enhance the safety and performance characteristics of general aviation aircraft?

The theory concerns the ability of fish and birds to maintain laminar fluid slowly over their bodies by extending scales or feathers, creating small vortices which tend to make the air adhere much better to the surface of their bodies, thus decreasing turbulence and drag.

Smoke tunnel tests were done on an airfoil that was very conducive to laminar flow. The airfoil was tested with and without scales. The results showed a 4 percent increase in the critical angle of attack for the two different scale configurations. This was significant enough to show a substantial increase in the section lift coefficient.

High speed tests were done on a modified radio controlled aircraft, and it was concluded that the scales would lift off due to upper camber low pressure, eliminating the need for a mechanical actuator. There was an increase in the low speed handling characteristics of the aircraft as well.

#HOLOGRAPHIC INTERFEROMETRY

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The purpose of this experiment is to apply the principles of holographic interferometry to the evaluation of the deformation of stressed bodies, especially in the vicinity of discontinuities. Holographic interferometry utilizes a double exposure technique, exposing the object prior to loading it and after it has been loaded. The resulting hologram has a series of nodal lines, or interference fringes, which record the dimensional changes of the object with a contour interval of 0.168 millionths of a meter. This procedure was applied to a series of cylinders with a variety of discontinuities and several types of uniform radial loads. Since holography is extremely sensitive, it was necessary to construct an optical bench, consisting of a sandbox containing 500 kg of sand, supported on inflated innertubes which isolated the holographic setup from vibrations. A 0.5 mw helium-neon laser was used in a split beam setup, exposing Kodak SO253 holographic film. The holograms were developed in a darkroom adjacent to the optical bench. The resulting holograms were viewed and photographed with ASA 1000 speed film. Interference patterns were then sketched, recording the deformation concentrations around the discontinuities. The deformation patterns were verified by comparison with conventional solid mechanics theory for shell distortion and stress concentration. This method of determining stress and deformation has significant potential for solving many practical engineering problems. An example of this is the reinforcement around a nozzle or drain in a pressure vessel. This method is effective because it may be applied to a laboratory model.

#First Award - Society of Photographic Scientists and Engineers
Second Award - Sigma Xi, the Scientific Research Society
Honorable Mention - Optical Society of America

THE CONSTRUCTION AND OPERATION OF A ROBOT

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My project dealt with the problems of building a small robot that would be capable of performing a number of different functions. This design and construction gave me insights into the operation of a simple robot.

The building of this robot became an involved and drawn-out process. It began with deciding what materials could be used and the availability of such items. Most of the items were those found around any household and garage. A few items, such as a fishing tackle box, electricial switches, and PCV pipes, were purchased at a supply store. An assortment of mechanical toys provided the gear boxes needed. Through trial and error, the assembly began to take shape. Re-designs were performed until all the functions operated correctly, and then the decorations were added.

The results was a robot performing a number of functions. Controlled by a switch board mounted on the rear, the robot is self-propelled. A swinging arm moves both clock and counter clock-wise, and up and down. At the end of the arm are mechanical fingers that open and close, grasping items to be moved. A wrench capable of pulling objects to the arm for pick up was added.

Through research and the building of this simple robot, I understand more of the importance of robotics in our modern world, and the growing importance of them in the future as they will perform many tasks that are too difficult and dangerous for man.

EXTENDING THE LIFE OF ORDINARY LIGHT BULBS

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Proposed is a new concept in efficiently extending the life of ordinary incandescent light bulbs. The concept is based on the electronic control of the bulb by means of filtered DC and a ramping voltage to prevent voltage spikes in the filament. A Resistor-Capacitor Buffer Isolater unit was first attempeted; it cost $51.50 to build, was capable of handling 200 watts, and lost 40 ma in heat dissipation. A smaller version was constructed, called the Solid-State Buffer Isolater, from a 16 amp, PNP power transistor. Its cost was $16, had a theoretical max handling power of 1,600 watts, and used 5 ma for control.

An apparatus was built to test the performance of the buffered bulb against that of a regular and half-wave rectified bulb. The computer command module sequentially turns on and off each of the three bulbs and then returns, keeping a count of the completed cycles. If one of the bulbs were to fail, the unit would halt and activate an alerting buzzer. That bulb would then be replaced and the experiment continued. To decrease filament cool-down time and thereby decrease the lifetime of each bulb, a network of muffin fans was added to the experiment. Provisions for a power failure were made by a battery back-up to save the data. After three seperate tests involving 75 and 250 watt bulbs, it was found that the half-wave rectified bulb lasted the longest, but its intensity was ½ of what it should have been. The B-I bulb, however, had the correct intensity and its life was found to be 3.9 times longer than the standard. Thus, such a device could be installed in traffic signals or patio lights.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

Third Award - Junior Engineering Technical Society
Fourth Award - General Motors ISEF

DETERMINATION OF FOIL COEFFICIENTS USING COMPUTER COUPLED HYDRODYNAMICS

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The hydro-tunnel is an incredibly high fidelity solution to the problem of testing airfoils, or hydrofoils accurately. The flow of water is powerful, while remaining smooth, and the greater density of water over air causes larger forces to be measured. In my experiment, water was pumped into a holding tank above a plexiglass tunnel, where it was temporarily stored. When the gate at the lower end of the tunnel was opened, the flow started and lasted for about five seconds. Because of this small time period when forces on the foil are present, I was unable to make measurements manually, and therefore I interfaced the computer to record the raw data. This data was in the form of force vs. time graphs, where the force increases until the water maintains a constant velocity for about two seconds, then it decreases when air enters the tunnel. The peak force was measured, and converted into lift and drag coefficients for many angles of attack. Seven different types of foils were tested to discover properties of shapes in a fluid flow, the error in the coefficients being approximately 8%. Graphs plotting the coefficients vs. angle of attack were created from the data, and they can be used to determine the forces acting on any size foil, in any fluid, at any velocity, as long as dynamic similarity is preserved. Therefore, there are many applications for this project, including determining coefficients for car bodies, rear view mirrors, boat keels, and possibly even buildings. This information is extremely useful for manufacturers of any moving bodies, or even stationary objects that are subjected to a fluid flow.

#THE DEVELOPMENT OF A SMALL SELF-CONTAINED PAYLOAD DESIGNED TO MEASURE THE EFFECT OF MICROGRAVITY ON FRICTION

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If man is to create an environment in space where he can live and work, a full understanding of the effects of a low-gravity environment is necessary. Because a knowledge of the force of friction is essential to the design of any working machine, a formula to calculate the effect of microgravity on friction would be valuable. The purpose of this project is to test the following **hypothesis: Given the requirements and restrictions set by NASA for small self-contained space shuttle payloads, it is possible to design and build an apparatus that will measure the effect of microgravity on friction and will provide all necessary data to develop a formula for the comparison of the coefficient of friction in 0g with that of identical materials on earth.**

Experimental **controls** consist of adherence to NASA specifications for size, weight, container usage, electrical components, experiment type, and safety. Modifications required by NASA were made by the experimenter without changing the purpose, and the original design consisting of an electric motor, aluminum wheel, cyclometer, and 12-volt battery evolved into the present **result**: an apparatus consisting of compressed nitrogen propellant, encased gyroscope, microprocessor, and 12 Gates lead-acid cells.

In its final form, the apparatus will still contain the basic elements of power source, gyroscope, sequencer, and data-gathering device. The **conclusion**, following retrieval after flight this summer, will be the determination of the amount of energy efficiency resulting from the low-gravity environment and the ability to extend this determination, in mathematical form, to other mechanical designs intended for space flight.

#First Award - General Motors Corporation
Third Award - American Astronautical Society
Third Award - General Motors ISEF

CARRIER SYSTEMS AND ATTENUATION COMPENSATORS

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"Carrier Systems and Attenuation Compensators" is a research into telephone transmission systems and their functions. The research paper defines the functions of a CM-8 Carrier System and a Fiber Optics System. The CM-8 System uses electrical transmissions, and Fiber Optics uses light transmissions.

The paper also describes Pulse Code Modulation equipment. This equipment is used with electrical systems as well as fiber optics.

This projects experiments involved standard electrical transmissions that are simular to those in the CM-8 System. A electrical transmission system uses frequency bands called channels to transmit conversations. Electrical transmissions have attenuation (energy loss) that increases as frequency levels increase. This affects the transmission channels in the higher frequency levels more than the lower levels.

The experiment tested a compensating device called a load coil. A load coil is a magnetic induction device that is used to amplify a transmission, especially the higher frequencies that have a higher attenuation level.

The experiments used transmission lines of different wire gauges at different distances, using loaded and non-loaded trials. The tests used frequencies at 200Hz to 3800Hz. The experiments were used to find the affects of different gauges of wire on a load coil. Tests were also run to find the affects of improper engineering on a loaded transmission line.

THERMAL CONDUCTIVITY OF DOUBLE GLAZING

Hudgings, Janice A., Kelly Walsh H.S., Casper, WY 82609
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Double glazing has widespread use in reducing heat loss through windows in residential and commercial buildings. The insulating effect of air gaps in double glazed windows was experimentally determined. A simple window was constructed of two polystyrene panes. Frame shaped spacers of six different thicknesses were used to produce an air gap of various widths between the panes. Attached to the outsides of the panes were two tanks, one of ice water and the other containing warm water. The apparatus was encased in two insulating foam ice chests. During each experiment, the heat lost from the reservoir of warm water through the double glazed window was measured at five minute intervals in order to determine the heat loss rate. Each heat loss rate was reduced to a single thermal conductivity. Several interesting systematic effects were encountered; however, the thermal conductivities determined were compatible with the accepted values. Heat loss was reduced approximately 70% by an air space. Over a wide range of air gaps, only a slight difference was observed in the thermal conductivities. The point of diminishing returns was about a 13mm air gap.

#STRENGTH OF TRUSSES

Robertson, Jeffrey, Walt Clark Jr. High, Loveland, CO 80537
1600 Morning Dr., Loveland, CO 80537

I proved that a truss is stronger than a straight beam. This was done by testing five different trusses using two specimens of each type chosen. Namely, the Warren, the Fink, the Pratt, the Queen Post, and the Double Trianglar were used. The trusses were tested by supporting the truss on the ends, while applying pressure to the middle part of the base of the truss. I measured the deflection and also measured when it broke. I measured single pieces of wood in both compression and tension. They were tested by pulling the wood aprt and by pushing the wood together. This was accomplished with the use of a hydraulic jack and spring in a wooden frame.

#Second Award - American Society of Civil Engineers

#SOLAR COLLECTORS - A NEW APPROACH

Ragsdale, Hugh A., Early H.S., Early, Texas 76801
Star Route 3, Box 19-C, Early, Texas 76801

One of the answers to our present energy-use problems is solar collection units; but the efficiency of these collectors is low; and the price tag is high. By the adaptation of the collector and the use of nigrosin (a black dye), experimental evidence was collected with single tube comparison to a stacked tube contrasting recycling of air, moist air, water and water with nigrosin. Average temperature elevation and decline per time unit (minute) were calculated, and an analysis was made of the data to determine kilocalories of heat gained or lost.

Nigrosin does increase the efficiency of the heat absorption by the tube; in contrast to all systems tested, however, the single tube in comparison to the single tube-stacked showed slower heat lost to the environment.

#Honorable Mention - American Intellectual Property Law Association

#AN MHD GENERATOR

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5818 Lassiter, Las Cruces NM 88001

Magnetohydrodynamic (MHD) power generation is a system wherein the motion of a conducting fluid through a magnetic field produces electricity.

The purpose of this project was to design and test an MHD generator which utilizes a hybrid-fuel rocket engine as its plasma source.

A prototype generator was designed and fabricated, appropriate test fuel grains were cast and sufficient instrumentation was provided to investigate concept feasibility.

The rocket engine uses oxygen and an organic polymer fuel. To increase ion concentration, metal salts are dispersed within the solid fuel of the engine. A dielectric channel fitted with electrodes is immersed in a magnetic field. By directing the plasma through the channel, electricity is extracted from the electrodes.

Problems involving channel material which was inadequate due to thermal shock became apparent during initial testing. In addition, the combustion characteristics of the polyester fuel resulted in almost immediate deposition of sufficient carbon within the insulating channel to produce a short circuit, creating a subsequent loss of usable power. These problems were partially overcome by improving channel material, reconfiguring the generator design and eventually changing the type of fuel used.

This system does produce electricity, however, considering the unresolved problems, it became obvious that further research is need to improve the efficiency of the system if it is to be useful for more than a few specialized applications.

#First Award - BDM Corporation
First Award - General Motors ISEF
First Award - U.S. Department of Energy
Second Award - United States Army

THE WAGTAIL MACHINE

Thorlakson, Chad E., Cavalier H.S., Cavalier, ND 58220;
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I started my project by trying to make a machine to create energy in a new and different way other than with a windmill or wind turbine. I decided to build a machine that creates energy by using the wind's power as a source of energy. I can use my machine either to light up a light or show how much voltage is being porduced on a voltmeter.

This is my second-year study on this machine. I have improved my machine a lot from last year's. Last year's machine produced, at the most, .9 volts; this year's machine has produced up to 1.8 steady volts.

The fan on my display is only being used to make the wind power. The wind is coming out of the fan at 12 to 14 mph. I measured the wind speed with an anemometer. On my machine I have two switches which are used to turn my voltmeter and my light on and off. I mounted the switches on the machine so I could shut the power off on the light or the voltmeter so one of them wouldn't draw too much current from the other.

I concluded that tail #2 produced the most steady current. Tail #1 produced the highest voltage but not the steadiest. Tails #3 and #5 had the lowest voltage readings.

I got most of my research from Popular Science, Popular Mechanics, and the World Book Encyclopedias.

COMPUTER ENHANCED PHOTOELASTIC STRESS ANALYSIS AND FLOW PATTERN DETERMINATION IN AERODYNAMIC STRUCTURES.

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OBJECTIVES: 1. To create precise molds eliminating inconsistancy in experimental resin aircraft models. 2. To determine the effect of wind pressure on the stress patterns of modern aircraft using polarized light and Photoelastic Stress Analysis. 3. To determine the flow patterns of each aircraft. 4. To create a computer enhancement system eliminating human error involved in visual analysis of each stressed aircraft model.
PROCEDURE: I initially created scaled down models of the three aircraft designs I planned to test (Flying Wing, Delta Wing, Swept-Forward Wing) using soft wood. I next made standardized molds of these wood models using fiberglass, then reproduced the aircraft shapes in caroplastic resin. Using a previously constructed wind tunnel producing 9.2 mph wind pressure, I annealed each resin model, then tested the effect of this in the Photoelastic Stress Analysis process. I duplicated each aircraft test, photographing the resulting stress patterns at set time intervals. In this stage I also used a mounted Magnehelic Differential Pressure Gage to determine the flow patterns of each aircraft. The final step involved designing and constructing a computer controlled analyzer which divided the photograph negatives, each showing aircraft internal stress patterns, into pixels and transferred its image to a monitor, enhancing the clarity of the aircrafts internal stress pattern.
RESULTS & CONCLUSIONS: I observed that as anticipated, the leading edges of each aircraft exhibitied the greatest fluctuations in their stress patterns. In terms of flow pattern, the wind pressure decreased rapidly along the trailing edges and wing roots of the aircrafts. The computer enhancement decreased human error and provided optimum results.

#First Award - General Motors Corporation
Second Award - Junior Engineering Technical Society
Second Award - National Aeronautics and Space Administration
Third Award - Society of Photographic Scientists and Engineers
Fourth Award - General Motors ISEF

ELECTRONIC DESIGNS IN A HOMEMADE ROBOT

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The purpose of this research was to design, engineer, and build a working model of an electronic robot which would have the ability to perform various household functions. Procedures involved a lengthy study period in order to become familiar with the function of electronic components. The components were purchased periodically as funds allowed and within approximately three years, the robot became a reality.

The robot, named Hurby, has five main circuits, primarily constructed by trial and error method. The circuits includes a touch-tone dialer, a photoelectric cell beam alarm, and blinking signal and reverse lights.

Hurby is approximately two feet in height, twelve inches in diameter, and weights ten pounds. He consists of approximately 200 ft. of wiring and 125 components which include intergrated circuits, resistors, capacitors, diodes, transistors, and various switches and relays. At present stage Hurby can be utilized as a mobile phone, provide lighting on command, and function as a burgular alarm. Future capabilities are planned.

The conclusion is that robots can provide necessary and desirable functions in the home environment. The human imagination is the major factor which will determine to what extent robots will be used in our future.

#SOUND AND LIFT-EFFICIENCY IN HELICOPTER ROTORS II

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A shortcoming of the modern helicopter is the loud and conspicuous noise of the revolving blades. This project is a study of the effects of various tip-vorticity-manipulation methods on the lift and sound efficiencies of an aftswept blade design, which had been previously judged to be lift and sound efficient, but unstable.

A unit was constructed to measure the lift of a rotor unit with a central hub used as the base for a variety of rotor assemblies. Blades were locked into the hub with setscrews, which allowed for two, three, and four-blade rotors, as well as adjustment of pitch and center of pressure. Lift readings were measured using a spring scale, while two microphones wired into an oscilloscope indicated sound levels as change in the amplitude of the broadband signal.

Two-variable readings were recorded for each rotor through three horizontal airspeeds, four coning angles, seven pitch settings, and three rotor speeds. A computer program was written for the Radio Shack TRS-80 Model III microcomputer to catalogue this data into random access files and performed all necessary calculations to tabularly and graphically display results for a thorough objective analysis.

Effective blades were those with a deep lift curve and a shallow sound curve. Blown tips and swirl generation methods resulted in 15% and 11% decreases from an aftswept blade, previously found to be 20% more sound efficient than the most effective conventional blade design. Such methods of vorticity manipulation also restored stability to the point it rivals that of conventional designs. This unexpected improvement is believed to be due to relocation and/or cancellation of tip vorticity, and stabilization of planar airflow within the rotor disk.

#First Award - General Motors Corporation
Second Award - BDM Corporation
Second Award - National Aeronautics and Space Administration
Third Award - General Motors ISEF
Honorable Mention - Acoustical Society of America

DESIGN AND USE OF AN INSTRUMENT TO MEASURE COEFFICIENT OF FRICTION

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Friction is the resistance to motion which takes place when one object is moved on another. The coefficient of friction is the relationship between friction and normal pressure. This experiment is the designing of a device to measure the coefficient of friction of different materials on steel. The instrument would be used to find differences of friction in materials, to observe how well different oils reduce friction and to show how water and heat affect performance in an automobile brake drum.
A brake drum was adapted to be turned by a motor, while the material being tested was held on the inside by a brake arm which could have weights added on the end. A small generator was mounted on the axle and attached to a volt meter. When testing materials, weights were added to the arm to bring the voltage down to .21 volts. Different materials and oils were tested on the drum at various temperatures. It was found that cork and leather had a higher coefficient of friction than brake material, which is made of asbestos. Man-made plastics like nylon and dacron had a low coefficient. Finally, it was observed that braking efficiency was decreased by 50% when water was added to the brake material and drum.

TERRACED AIRFOILS III

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I HYPOTHESIS For the past two years, the "TERRACED AIRFOILS" projects have demonstrated the positive effects acquired by terraced airfoils in controlling stalls. This year, a computer-assisted simulated real-time stall test will be conducted, and three years of experimentation will culminate with the actual flight testing of terraced airfoils on a radio-controlled glider. Will the flight tests verify previous results?

II TEST PROCEDURES During the simulated real-time stall test, lift production from the control and terraced wing sections was measured with a 10-pound load cell, amplified, and delivered to a modified joystick, thence to the Heathkit 131 computer. Angle-of-attack was simultaneously measured by a 500 K potentiometer, fed into the computer, and plotted.

To flight test terracing, a radio-controlled glider was outfitted with a terraced left wing. The glider was flown and put into a stall while concurrently being video taped for subsequent close analysis of the wing's response.

III CONCLUSION Additional, more advanced equipment, producing 40 times more information than 1983's project and four times more data than last year's experiment, yields the same results: terracing produces slightly less lift overall but moderates stalls, making them less severe and occur at higher angles-of-attack.

Before flight testing commenced, it was anticipated that flight would be characterized by an initial left roll due to the greater conventional airfoil lift, and then a roll right as the "normal" wing stalled first. This is exactly what occurs.

#First Award - National Aeronautics and Space Administration
Second Award - United States Air Force

A NEW, IMPROVED DUAL-AXIS SOLAR TRACKING UNIT

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An accurate dual-axis solar tracking unit could be a relatively inexpensive option to maximize the energy output of most solar collectors. A unit such as this was designed with a photoresistor array controlling the movement of the unit. The movement is dictated to the motors controlling the unit by the output of an operational amplifier which produces an output signal based upon the voltage drop across the pairs of photoresistors in the array. The energy output of the parabolic collector mounted on the tracking unit was compared to that of an identical fixed parabolic collector by recording the voltage generated by thermocouples mounted at the focus of each collector on identical strip chart recorders. Analysis of data revealed that the average temperature of the tracking unit's collector was 390% higher than that indicated by a standardized curve which reflects the optimum performance of the fixed collector. It can be concluded that this new dual-axis solar tracking unit can inexpensively improve the efficiency of solar energy collection.

#Scholarship - Ohio State University
Third Award - Institute of Electrical and Electronics Engineers
Honorable Mention - U.S. Department of Energy

#THE EFFECTS OF BOUNDARY LAYER REMOVAL

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The removal of a low energy layer of air off of the upper surface of an airfoil will delay laminar flow separation and allow lift to be increased or maintained where normally it has been destroyed. One such process for accomplishing this, known as boundary layer control by suction, is the focus of this four-phase experiment. By mechanically sucking this thin layer of stagnant air off the upper surface, lift was expected to increase as high as 30 percent. Data provided by Phase II not only indicated the effectiveness of such a process, but that increases in lift coefficients as much as 80 percent are attainable.

Phase III data (flow visualization analysis) visually confirmed the delaying of flow separation as hypothesized in 1981's Phase I experimentation. In addition, results indicate that even a completely stalled airfoil is easily recoverable by the boundary layer removal process. Phase IV experimentation focused on establishing the relationship between the amount of suction applied and the resulting increase in lift. Data provided indicates a non-linear relation between suction and lift.

From these results it can safely be deduced that boundary layer removal incorporated into future aircraft designs will reduce fuel consumption, shorten the distance required for take-off and landing, increase the load carrying capacity, and make aviation in general safer by supplying more lift in emergency situations.

#First Award - General Motors Corporation
First Award - International Aerospace Hall of Fame
First Award - United States Air Force
First Award - U.S. Department of Energy
London International Youth Science Fortnight - United States Navy/
Naval Air Systems Command
Second Award - General Motors ISEF
Second Award - National Aeronautics and Space Administration

BIAXIAL STRESS ANALYSIS ON CANTILEVER WINGS

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This investigation compares the cyclic, fatigue force of lift to the static force of drag to determine the significance of the force of drag on an airplane wing.

Specimens were constructed to represent a plane wing. One half was fitted with rectangular shaped attachments at the base, and the other half was fitted with tapered attachments. The attachments represented a fixture at an airplane's wing root and provided rigidity during loading.

Testing was conducted through both uniaxial and biaxial loading. Both attachment designs were fatigued uniaxially and then fatigued with a static load to one side. The service lives of the specimens were compared to determine which attachment design provided the most rigidity and which type of loading was capable of withstanding the greatest number of cycles until failure.

The testing proved that the tapered attachment provided the greatest rigidity for the specimen. It also proved that the additional static loading neutralizes the area of stress concentration at the base of the specimen, and the additional tension causes the nucleation site to begin on an outer edge of the specimen as opposed to the center.

#A THREE YEAR STUDY OF THE EFFECTS OF SOLAR HEATING A SPACE ENCLOSED BY AN ENVELOPE

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The research was initiated three years ago to analyze the envelope house to find out how and why the house style worked. Even now, the house is still a topic of controversy; many professionals disagree with the original theory arguing that there are many factors not accounted for in it. It is the hope of the researcher that this analysis will produce evidence to demystify the workings of the envelope house.

The central purpose of this research is to analyze the heating and cooling cycles of a Basic Convective Loop house as originally designed through methods including temperature analysis, infra-red photography, and convective current tracing. The research is intended to provide a reasonable theory on the workings of a BCL house that will form a foundation for improving this house style.

Solar radiation will heat the greenhouse air; it will also account for a large amount of the heating in the first floor living area. However, the highest percentage of heating for the first floor living area should be caused by convection from the greenhouse. Because of a temperature imbalance, the heated greenhouse air will slowly move into the upper loop section. The second floor living area is heated by convection mostly from the greenhouse and partly from the first floor living area. The loop should act as an insulator. Air movement during the cooling cycle will first slow down then reverse.

The research supports the following theory that insolation heats the greenhouse air. Some warm air does enter the upper envelope, but not very much since loop temperatures are the lowest in the system. The living area is warmed through convection transfer of heat from the greenhouse air; the envelope acts as an insulator.

#Fourth Award - General Motors ISEF

WILL THIS IDEA FLOAT?

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The purpose of my project is to design a method of determining whether a boat will float at its waterline before putting it in water. To do so, a comparison of the boat's size and the amount of water the boat would displace is made.

The method I have developed could be of aid to ship designers and engineers. The concept could lead to a very useful method of ship design.

The main problem I encountered in my work was determining the displacement volume of a ship. To overcome this, I designed a computer program which processes data collected from measurements of a ship's hull to find the weight-to-volume ratio.

Because I had no real ships to collect data from, I used a scale model of the German World War II battleship *BISMARK*. The hull of the model has been included in the display.

To test the program, I filled the ship with sand until it floated at the waterline and then weighed the sand. Then I measured the volume of water the ship had displaced.

#DESIGN AND CONSTRUCTION OF A COMPUTER-CONTROLLED ANOMALOSCOPE

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An anomaloscope is an optical instrument used for the diagnosis of red-green color blindness and color anomalies. A new design, using computer control instead of optical control, reduces cost while increasing ease of use, flexibility, and performance.

Observers match halves of a yellow-red/green bipartite field by adjusting the intensity of the yellow side and the red/green (R/G) ratio of the other side. After the observer adjusts the halves of the bipartite field until they match, the computer records the intensity and the R/G ratio for use in diagnosis.

Linear control of light intensity is achieved by directly regulating tungsten bulb sources and monitoring the sources with linear photodiodes. The computer functions as the comparator in a servo system, adjusting light intensity according to the observer's settings, and maintains the R/G mixture at constant luminance. A triac control interface and a digital photometer were constructed to allow the computer to adjust and monitor lamp intensity.

Anomaloscopes are widely used to test color vision, as in the assessment of candidates for specialized training (pilot training, submarine training, etc.). Recently they have been used in the study of acquired color vision defects; for example, to monitor the changes caused by diabetes and other diseases. An easily used low-cost anomaloscope could encourage wider use of accurate color vision testing.

#First Award - Institute of Electrical and Electronics Engineers, Inc.
Alternate to Scholarship - Ohio State University
Third Award - General Motors ISEF

#DEVELOPMENT OF ENGINEERING DESIGN PARAMETERS FOR ALUMINUM-AIR FUEL CELLS

Knight, Jonathan P., Melbourne Central Catholic H.S., Melbourne, FL 32901; 5260 Palomino Drive, Melbourne, FL 32935.

The purpose of this research was to establish engineering design parameters for an aluminum-air fuel cell. To carry out the project, a fuel cell test bed was constructed to permit experimentation with important cell components. Regression analysis was used to establish empirical relationships between controlled input variables and cell electrical production. Also, computer simulation was used to study the dynamics of the cell polarization and equilibration processes.

As a result of the empirical study, it was found that electrolyte concentration, the exposed Al fuel surface area, and oxidizer gas pressure were statistically significant variables affecting cell output.

Cell output was also observed to be affected by peroxide formation and carbon dioxide poisoning of the cathode. Two unexpected results obtained from the experimentation were (1) an inverse relationship between oxidizer pressure and cell output, and (2) a substantially greater cell output when air was the oxidizer gas versus pure oxygen.

#First Award - General Motors Corporation
First Award - U.S. Department of Energy

THE DEVELOPMENT OF A SYSTEM FOR ACQUISITION OF 3-DIMENSIONAL IMAGES

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Sight is our most relied on sense. We use it in almost everything we do. In order for a device possesing artificial intelligence to be able to interact with its environment as we do, it would need some way of seeing the things around it. It would need a system for getting three-dimensional images of its surroundings.

In my project, I developed a system, to be used by a computer, for getting digitized images of three-dimensional objects. My system utilized a small neon laser and a system of motors and mirrors to scan the surface of the objects. After a great deal of experimentation with photodetectors, I developed a successful array of photodetectors to guage the distance of the laser spot. It utilized three specially modified cadmium sulfide cells and a 216 fiber optic light guide to collect and distribute the scattered laser light. I designed and built a circuit to process the outputs of the CdS array which I interfaced to a Commodore 64 by adding three input ports to the expansion port of the computer. I designed a program to decode the output of the array and to store it on disks. I developed a system of assembly language graphics routines which plotted the image in simulated 3-D and removed the hidden lines from the plotted image.

Although my system is still a prototype, it has produced surprisingly good results. It has a fairly low resolution and a limited range, but the data is consistent and free of noise. I plan to improve the resolution and accuracy of my system and to go on to image recognition.

#First Award - Ball Electronic Systems Division
First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - Glenn T. Seaborg Nobel Prize Visit Award
First Award - Junior Engineering Technical Society
First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Third Award - American Intellectual Property Law Association

A COMPUTER REMOTE CONTROLLED BUOY

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This project relates to the problem of transmitting bidirectional high resolution digital data over a radio link. Its application resulted in the development of a computer controlled remote buoy.

The system uses an APPLE II computer as controller that sends asynchronous serial data to a modem which in turn modulates a CB radio. On the buoy end, another CB radio receives the signal and its demodulated audio is sent to a modem that restores the original data. A mark was chosen as 2400 Hertz and a space as 1200 Hertz. Said digital data are inputted into an Universal Asynchronous Receiver/ Transmitter (UART) that decodes the serial data into parallel data for decoding of the individual control functions.

During testing of the system, local noise from motor and light switching was discovered to false trigger the digital circuits resulting in unpredictable operation. That prompted me to install two fluorescent lamps to saturate the system with noise with which to learn and apply the techniques of noise elimination.

The selection of digital transmission and noise elimination gives a better than 90% reliability and by using echo techniques, that can be raised to better than 99%.

#UTILIZING THE HYDRODYNAMIC POWER OF OCEAN WAVES

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Ocean waves, crashing and thundering on the coastlines of the world, represent an untapped reservoir of renewable energy equal to all the electric power generated in the world today. Driven by winds across vast expanses, wave power has been almost totally ignored, and the few research efforts to harness this reservoir of energy, mostly in Japan and England, have relied on devices on the surface of the ocean. Such devices would be destroyed in a severe storm. I conceived, designed, tested, and am patenting a device that would operate underwater, thereby escaping the fury of a storm. This device successfully harnessed the changing hydrodynamic pressure of ocean waves and generated electric power.

An air filled constant pressure reservoir on the beach was connected by a hose to the submerged wave machine. The machine consisted of a cylindrical water filled outer casing and an air filled inner flexible bladder. When a wave crest was above the machine, the water pressure collapsed the bladder, forcing water into the outer shell. The force of the water entering the shell turned a turbine connected to a generator. During a wave trough, the process reversed, expelling the water through a second generator.

A companion device to measure the hydrodynamic pressure of waves was constructed, and the data recorded was used to calculate the power available in an ocean wave. A conceptual full scale device has been designed. Practical limitations and further applications of this exciting and revolutionary technology are described.

#First Award - Allegheny International
First Award - General Motors Corporation
First Award - Marine Technology Society/U.S. Naval Institute
First Award - Society of Women Engineers
Operation Cherry Blossom - United States Army
Scholarship - United State Marine Corps
First Award - U.S. Department of Energy
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Third Award - General Motors ISEF

#COMPUTATIONAL FLUID DYNAMICS

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With the advent of high speed computers, Computational Fluid Dynamics has become an active area for research and investigation. New theories attempt to describe the aerodynamic characteristics of objects submerged in fluids and use these data in the design of new cars, planes, wings, etc.

This project analyzes a simple mathematical model of the flow of an ideal fluid past an object by means of a computer. This model is compared against the flow of water past objects to determine its validity. The results are incorporated into a program which computes simple aerodynamic characteristics of arbitrarily shaped bodies submerged in an ideal fluid, and can be used as a simple design tool.

#Honorable Mention - Bureau of Reclamation/U.S. Department of the Interior

2XLINXS: THE ONGOING SUCCESSION OF ROBOTICS TECHNOLOGY

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About seven years ago at age ten, I became interested in the field of robotics through movies and pictures. I had always enjoyed working with electronics and mechanics. I decided to put this basic knowledge to the test by constructing the best, most human-like robot that I could.

My work became increasingly better as time passed. This can be seen by examining the three prototypes I have created. It took me about two years to complete my first robot, SEGMO. I was less than satisfied with the finished product and knew I could do better. The second robot, ARTI, took about one year to finish but it still had some design flaws.

2XLINXS, the third robot, only took about six months to complete. This was possible due to the experience I obtained while constructing the other robots. It is stronger than a human being in most respects. 2XLINXS is powered by motors that produce 250 in. lbs. of torque at only a 3.8 amp current draw. It weighs about one hundred and forty pounds. It is controlled by a very advanced computing system. 2XLINXS is constructed in sections, therefore, it can be easily modified and updated to keep up with today's quickly advancing technology. This eliminates many of the problems found in the previous models.

After seven years of diligent work, I believe I have reached my goal by constructing a very human-like robot. In the future I plan to construct robots on a large scale to be sold on the open market.

#Second Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

ENVIRONMENTAL SCIENCES

GROUND-WATER POLLUTION - IDENTIFICATION, ISOLATION AND REHABILITATION

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About half of the U.S. population and 95 percent of rural Americans rely on ground-water for drinking and other domestic uses. In addition, large quantities are used for agricultural and industrial purposes. Quality deterioration of this vital natural resource, resulting from man's activities, is a major problem in the United States. Identification, isolation, and rehabilitation of contaminated aquifers is the major challenge facing environmentalists today.

This research project was designed to help solve these three problems by providing improved methods to: 1) Identify ground-water pollution, 2) Isolate and prevent migration of ground-water contaminants, and 3) Rehabilitate contaminated ground-water aquifers. With this objective, a ground-water model was constructed of plexiglas, filled with sand and designed so water would flow through the model. A dye, simulating pollution, was then introduced and followed visually through the model. Three wells were inserted into the model to simulate the effects of pumping and injection on pollutant movement.

The results were: 1) Pollutant detection time, efficiency and economics were significantly improved by ground-water drawn to a pumping well, 2) A hydraulic barrier, halting ground-water pollution migration, could be constructed by injecting fresh water downstream of the pollutant source and 3) Rehabilitation of the polluted aquifer could be accomplished by injecting fresh water into perimeter wells while pumping contaminated water from the center of the contaminated zone.

#REDUCING KITCHEN POLLUTANTS: NITROGEN DIOXIDE KINETICS

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High levels of air pollutants can occur in indoor environments where we spend most of our time. This is especially true for kitchens where cooking produces airborne food particles, gas stoves produce nitrogen dioxide and food odors travel throughout the house. Most ventiliation systems are inadequate in reducing the levels of these pollutants. The purpose of this study is to measure exposure to nitrogen dioxide (NO_2) during use of a gas stove, and design a system to substantially reduce these pollutants.

With adequate air exhaust I hypothesized that nitrogen dioxide and other pollutant concentrations from a gas stove could be sufficiently reduced and eliminated as a hazardous indoor pollutant without excessive heat loss. Two exhaust systems were constructed, the first used a vacuum cleaner tank and had an exhaust rate of $1.6m^3$/min. and the second used a squirrel cage fan with an exhaust rate of $5m^3$/min. A counter current parallel flow heat exchanger was constructed and entering and exiting air temperatures were measured to determine the heat exchange efficiency.

The NO_2 concentrations were measured using the Saltzman Method. As NO_2 is bubbled through an absorbing reagent, a color change occurs and optical density is measured with a colorimeter.

From these studies it was determined that exposure to NO_2 and indoor pollutants often occur in higher concentrations than exposures in the outdoor environment and higher rates of exhaust are required to reduce these levels. A heat conservation device is desirable and a heat exchanger can be very effective.

#Fourth Award - General Motors ISEF

#WIND GENERATED HYDROGEN GAS PRODUCTION

Teplitz, Steven, Tottenville HS, Staten Island, NY 10312; 668 Sheldon Ave., Staten Island NY 10312.

Due to the steady depletion of fossil fuels, scientists have looked at alternative fuels for the future. Scientists have looked at renewable fuels that will meet the demands of the future.

For the past three years, I have worked on combining the renewable aspects of wind power with the high energy, low pollution aspects of hydrogen for automobiles. The main idea of my experiment is to have an automobile run on hydrogen which is produced by wind power. With only wind and water as energy materials, an automobile could theoretically run efficiently.

The first part of my experiment was to build a windmill that would produce the optimum amount of electricity. A windmill was constructed of PVC plastic tubing and stands approximately eight feet (without blades). A 12 volt D.C. motor was used as a generator within the windmill vane.

After finding the most efficient blade, a Hoffman apparatus was permanately attached to the generator. The hydrogen gas was stored and later used in a small internal combustion engine. The gas was directed into the air intake of the engine. There were no changes to the engine. While running on hydrogen, the RPM was measured, the exhaust analyzed, and the power calculated. I compared the results with those of gasoline and found that hydrogen is an excellent fuel for cars. A car can run off of the wind.

#Fourth Award - General Motors ISEF

DO YOU KNOW WHAT YOU'RE DRINKING?

Reinhardt, Kirstan G., Loudoun County High School, Leesburg, VA 22075, 302 Edwards Ferry Road, N.E., Leesburg, VA 22075

This project was designed to evaluate and compare the different water systems of Loudoun County, Virginia. First, basic background data, including population, daily water usage, water supply system and purification method(s), and billing rate, was collected on each town or community. Then, samples of water from each town were collected and tested for quality at the Potomac Intake and Treatment Facility. After evaluating the water quality and determining the overall efficiency of each system, conclusions were drawn to recommend alternative methods of water supply for towns lacking an adequate system. Leesburg and Middleburg already have highly efficient systems. Hillsboro, Lovettsville, Waterford, and Eastern Loudoun have adequate supplies but need to make slight adjustments in quality (iron and aggressive indices). Purcellville, Hamilton, and Round Hill need to make drastic improvements, immediately. Of all the possible ways of doing this, the most practical one would be for these towns to buy water from Leesburg, as the Potomac plant can easily meet the needs for all four towns.

The second part of my project dealt with the Loudoun County Sanitary Landfill, which has contaminated several domestic wells in its vicinity. The landfill is out of space, and plans have been made to expand it, which will only make the contamination problem worse. Thus, the county needs to consider other methods of solid waste disposal. Of all the possibilities, a system involving recycling of all reusable materials and incineration of the rest seems most feasible for Loudoun.

POLUTION SOLUTION

Roop, Timothy J., South Florence H.S., Florence, SC 29501; 1155 Pinckney Ave., Florence, SC 29501.

The purpose of this research is to determine the feasibility of carrying out further studies on the toxic effects of effluents released from coal-burning power plants. In this study chlorine and lead were studied. The copepod Cyclops was used because of its main nich in the food chain.

Four concentrations of lead (1, 5, 10, and 50 parts per million) and five concentrations of chlorine (1, 5, 10, 50, and 100 parts per million) were tested. Five animals were placed in each concentration, and were observed for a 48 hour period, at the following intervals: 30 min, 1, 2, 4, 8, 16, 24, 36, and 48 hours.

In these experiments, one would expect that higher concentrations of pollutants would cause higher rates of mortality. Experiment one, the exposure of Cyclops to lead, demonstrates this idea consistently. It can be concluded that lead in concentrations above 1 ppm is lethal to copepods within 24 hours of its being introduced into the aquatic environment.

The results of experiment two, the exposure of Cyclops to chlorine also follows this hypothesis. The results show that concentrations of 5 ppm chlorine and above are extremely toxic to copepods.

In conclusion, I feel that this research project has been a complete success. I have proven that large scale research of a similar design is feasible. I have learned how to maintain a large supply of Cyclops. I have also learned how to make up test solutions of many different concentrations. In summary, I have established a protocol by which to pursue a more comprehensive study dealing with the effects of the effluents from coal-burning power plants on aquatic ecosystems.

#ATMOSPHERIC DEPOSITION: ITS EFFECTS ON THE EMBRYOLOGY AND BREEDING BEHAVIOR OF JAPANESE MEDAKA FISH

Ernst, Todd M., Wayland H.S., Wayland, MI 49348
424 131 St. Avenue., Wayland, MI 49348

Acid rain is a simplified term for acidic deposition, which includes rain, snow, dew, gases and even dry matter with pH levels below 5.6. This project involves the study of the effects of acid rain on various stages of the fish's life, and a long term examination of the ability of lime to act as a polluted aquatic environment inhibitor.

I first investigated how acid rain affected fish embryo development and the embryos' ability to hatch. The second experiment involved the lowering of the pH in an experimental aquarium in which I observed breeding behavior of the Medaka. The third lab required the administration of lime to study its ability to neutralize the effects of simulated acid rain.

Acid rain pollution caused a loss of cilia from embryonic Medaka shells (possibly due to a softening of the shells) a change in the color of the shells, and eventual death. The breeding behavior in an acidic environment was not affected, but the percentage of unfertile eggs produced by these fish increased markedly.

Lime proved to be an inadequate solution to the acid rain problem. When acid rain was added the pH dropped. Within 24 hours the lime neutralized the acid, and the water returned to its normal pH. However, the initial drop in pH and the repeated fluctuations in pH subjected the fish to undue stress and caused their eventual death.

Since the addition of lime to an acidic environment is an inadequate solution to the pH problem and because no other "corrective" solutions are available, the available answer to the acid rain problem is to stop acid pollution at the source.

#Honorable Mention - U.S. Department of Energy

#Chemically Contaminated Ground Water as Detected by Planarian Regeneration

Oraker, Jeffrey E., Doherty High School, Colorado Springs, CO 80917

3060 Caravan Ct., Colorado Springs, CO 80917

The purpose of my experiment was to determine whether or not chemically contaminated ground water could be detected by planarian regeneration. Planaria are small flatworms with the amazing ability to regenerate lost body parts. For my experiment, I used the regeneration of the head. I chose 13 contaminants for experimentation with 9 being carcinogens and 4 non-carcinogens.

I measured the 9 carcinogens to a concentration of 1 part contaminant to $1x10^{10}$ parts water. 135 planaria were decapitated and 15 put into each solution. Regeneration time was recorded and the results were tabulated. I found a significant difference between the regeneration time in the contaminated water when compared to the regeneration time in the uncontaminated water. I decided to investigate further.

Next, I repeated the above procedure only this time I varied the chemical concentrations. They ranged from 1 part contaminant to $1x10^{5}$ water all the way to 1 part contaminant to $1x10^{11}$ parts water. When planarian regeneration was completed and the results tabulated, I found significant differences in the average times of planarian regeneration in the varied chemical concentrations.

Finally, I mixed chemicals together making a simulation of a real contamination problem in Wisconsin. Once again, the results were significant as all the planarians died within 18 hours.

I concluded planarian regeneration can determine whether or not ground water is chemically contaminated.

#Fourth Award - General Motors ISEF

A FIVE YEAR ACID RAIN ANALYSIS THROUGH VARIOUS STUDIES

JOY COBB
CHOCTAWHATCHEE HIGH SCHOOL
552 BOB SIKES ROAD (APT. A)
FT. WALTON BEACH, FL 32548

This is my fifth year on the "ACID RAIN ANALYSIS THROUGH VARIOUS STUDIES" project. These studies show the effect this problem has on our environment through different forms of life. The names of these studies are The aquatic Life Studies, The Microscopic Life Studies, The Natural Environment Studies, The Seed Germination Studies and The Aluminum Pollution Studies. The latest studies added are The Nitrogen and Sulfur Studies and The Porous Tube Soil Water Sampler Studies. The first is a study that is done periodically and checks for the amount of N, NO3 and SO4 in the rain samples. The second is the development of a new model of a soil water sampler which is used in the field now to collect the soil water samples for my research of the PH level versus the buffering capacity of our soils. Besides these studies and the collecting of soil water for analysis, I have also for the past five years collected rain samples in eleven rain stations and kept up with as well as graphed the PH levels for Okaloosa County. With the development of this original soil water sampler and the original research for the past five years, I have made breakthroughs as far as being a step ahead of the acidity problem. Being able to now collect both rain and soil water, a comparison has been made to discover if the PH level can be changed through the soil. All of these studies are detrimental to the knowledge of the problem and therefore will be furthered studies as I enter college.

ALUMINUM IN GUAM'S WATER

Page, Marie L., Vocational High School, GCC, Mangilao, Guam 96913
P.O. Box 20835, GMF, Guam 96921

Guam has two nerve diseases that are killing the people of Guam at an abnormally high rate. The need to determine the cause is the basis for this study.

This study offers substantial evidence for the hypothesis that excessive, aluminum consumption via the water supply by long-time. Guam residents is the primary cause of the two diseases, Amyotrophic Lateral Sclerosis and Parkinsonism Dementia (ALS and PD).

A Neurologist found that the aluminum bonds to the nerves, producing motor or judgemental disfunction depending upon the location.

Water samples were taken from the island of Hawaii and from the State of Arkansas (which is the Aluminum Mining Capital of the United States) in addition to Guam Samples. The Guam samples showed higher levels of aluminum than those samples taken from the states.

Using the Standard Method for the Examination of Water and Wastewater, used by the American Public Health Association, I tested drinking water sources on Guam, including rivers, wells, and households. Then I obtained death statistics for ALS and PD by village from a medical report. These statistical comparisons are reflected by graphs showing the distribution of Aluminum found in the village drinking water and the death rate from ALS and PD per village.

Examination of the graphs seems to show a definite correlation between the amount of aluminum in the village drinking water and the death rate in the various villages.

#Second Award - Association for Women Geoscientists Foundation
Third Award - General Motors ISEF

#OLFACTORY INHIBITORS IN DRILLING FLUID

De Arman, Mike D., A&M Consolidated H.S., College Station,Tx. 77840
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In an attempt to isolate the chemical(s) in petroleum fluid that inhibit olfaction in freshwater fish, Gambusia affinis were exposed to each of the three main components of drilling fluid at the equivalent 1 ppt. of the pure fluid, as well as the pure fluid itself at 1 ppt. When tested in a two-choice observation system, G. affinis showed no significant left/right bias in control experiments (no infused chemicals). To a $1x10^{-3}$ solution of l-Alanine G. affinis showed an 80% positive response. After 24 hours of exposure to drilling fluid, G. affinis showed a 53.33% positive response toward a 1 ppt. solution of l-Alanine. After exposure to equivalent concentrations of cellulose and sodium hydroxide (NaCl) no inhibitory effect on positive orientation to l-Alanine was exhibited. After 24 hours of exposure to Bentonite clay at the appropriate concentration, a 56.67% positive response toward l-Alanine at $1x10^{-3}$M was recorded. This suggests that Bentonite is the olfactory inhibitor in drilling fluid.

#Third Award - General Motors ISEF

A COMPARISON OF GEOTHERMAL SPRINGS

Schneiter, Troy L., Weber High School, Pleasant View, Ut. 84404
2368 N. 150 W. N.Ogden Utah 84404

Water, algae, and soil samples have been taken from various hot springs throughout northern Utah, and southern Idaho. The temperatures of the springs plus the pH and different tests that measure the chemical contents of the water have been taken. The algae was identified under a microscope to determine the species of the algae living in each of the springs. Also I have done tests on the soil to determine whether or not the soil is suitable for plant growth, contrary to the absence of plants surrounding the springs. The results of all of the above tests in all seven springs tested have been compared to determine similarities and contrasts.

EFFECTS OF OUTBOARD MOTOR EXHAUST ON SELECTED MARINE ORGANISMS

Gann, Melissa E., E.D. White Catholic H.S., Thibodaux, LA 70301
431 Easy Street, Thibodaux, LA 70301

This project is a study of the effects of outboard motor exhaust water on three marine organisms. The organisms chosen for this study were the ciliate protozoan, Tetrahymena pyreformis, the fresh water grass shrimp, Palaemonetes sp, and the Japanese Medaka, Oryzias latipes.

The standard static bioassay test tube technique was used with Tetrahymena pyreformis. Growth was measured gravimetrically. By interpolation, the effective concentration, 50 per cent, was found to be 2.1 per cent exhaust water.

The effect on Palaemonetes was determined by means of a flow-through bioassay technique. The EC 50 was found to be 0.66 per cent at 48 hours and 0.62 per cent exhaust water at 96 hours.

Oryzias latipes eggs were used rather than adults. The effects of exhaust water on egg hatchability and fry survival after embryo exposure were observed. It was found that exposure to exhaust water in the 1-3 per cent range increased incubation time and decreased hatchability. The survival rate of fry which had been exposed to exhaust water as embryos was reduced.

EFFECT 2,4-D IN RHIZOPHORA MANGLE - RED MANGROVE

Deliz, Jeannette, Esc. Sup. A. Irizarry de Ruiq, Toa Baja

Bo. Ingenio, Toa Baja, P. R.

The problem investigated was how does gerbicide 2,4-D hormonal affected the growth of the planting of the Rhizophora Mangle. The hypothesis of the investigation are:

1) If 2,4-D affects negatively the growth of mangrove Rhizophora, then by putting various plants in different solution of 2,4-D they will suffer a gradual regression in the normal growth.

2) If 2,4-D affects positively the growth of Rhizophora Mangle, then by putting various plant in different solution of 2,4-D they will accelerate the growth.

This test were made in accordance with the methods of a bioassay. The test was done in a transfixed position where the plants were exposed to various concentration of 2,4-D for a period of 20 days. The results were the following: The plants exposed to a concentration of more than 15 ppm suffered gradual regresion in growth. In the plants exposed to .126, .252, .390 ppm there was an acceleration in the growth. Based on the results the conclusion is: there is a negative effect of 2,4-D in Rhizophora in major concentration therefore, hypotesis number (1) is accepted (true), there is a positive effect of 2,4-D in Rhizophora Mangle in lesser concentration of 1.0 ppm, therefore, hypotesis number 2 is accepted (true).

SUGAR LAKE'S PHOSPHORUS BUDGET SHOWS CULTURAL IMPACT, BUT THE LAKE REMAINS OLIGOTROPHIC

Whiteford, Jeffery A., Grand Rapids H.S., Grand Rapids, MN 55744; Route 1, Box 444, Cohasset, MN 55721.

The main objective of this study was to classify Sugar Lake according to its trophic state, determine its sensitivity to phosphorus loading, calculate the phosphorus budget, ascertain its carrying capacity, and predict the impact of future lakeshore development.

The lake was monitored seminonthly from June through October at six sampling sites. Measurements of total phosphorus, chlorophyll a, water clarity (secchi disc), dissolved oxygen, pH, and water temperature were recorded for analysis of water quality, trophic condition, and to determine the phosphorus budget, sensitivity to phosphorus loading, as well as the lake's potential phosphorus reduction and mobilization control.

The lake has been of high water quality for the past two years of study and appears to have maintained that position through this study period. Vollenweider's (1975) nutrient model along with Carlson's (1977) Trophic State Index indicate that Sugar Lake would be placed in the oligotrophic range. According to Dillon's (1974) retention coefficient and the methods listed by Garn and Parrott (1977), response rate of Sugar Lake, for a given phosphorus loading, is much less than that of a sensitive lake.

#First Award - Water Pollution Control Federation
Second Award - General Motors ISEF
Second Award - United States Army

DIEL ACTIVITY AND RELATIVE ABUNDANCE OF MICROCRUSTACEANS IN A LAKE COMMUNITY

Payne, Christopher, White Station H.S., Memphis, TN 38117, 6214 Shady Grove Lane, Memphis, TN 38119.

Planktonic organisms constitute a vital link in the food chain of all lakes and an understanding of specific characteristics of lake plankton populations. The microcrustaceans components of the plankton in Lake Rohco, Shelby County, Tennessee, were studied in this research, more specifically the copepods and cladocerans were examined to determine if:

1. distinct pattern of vertical movement occurred within the water column during one 24-hour cycle (diel movements) and,
2. the ratio of these two groups within this lake would permit a statement of the lake's productivity.

Samples were obtained with a Van Dorn water sample and were taken from the lake's surface and bottom just prior to sunrise, and just prior to sunset. Each sample of 30l was filtered through a fine mesh plankton net, and preserved.

Counts of microcrustaceans from Lake Rohco suggested that:

1. Copepods exhibited strong diel movement toward light,
2. cladocerans displayed no apparent diel movement, and
3. in Lake Rohco, copepods out-numbered cladocerans 5:1, characterizing this as a relatively unproductive lake.

THE EFFECT OF INCREASED LIGHT EXPOSURE ON GRAFTED HIBISCUS PLANTS

Myers, Martha Jo, Davenport Central H.S., Davenport, IA 52803
1515 Jersey Ridge Rd., Davenport, IA 52803.

All green plants produce energy from light by means of photosynthesis. If the amount of light a plant is exposed to is increased, is the amount of energy it can produce proportionally increased? And will too much light stunt the growth or even kill the plant? HYPOTHESIS: LIGHT EXPOSURE AND PLANT METABOLISM ARE DIRECTLY PROPORTIONAL WHEN THE PLANT IS NOT STUNTED BY TOO MUCH LIGHT.

By grafting two plants from the third in each of four groups of Hibiscus rosa-sinensis, a gauge of plant growth is made. It is assumed that greater metabolic activity will show up by the graft forming callus growth earlier. Plant groups A, B, C, D are exposed to 12, 16, 20, 24 hours of light per day respectively. Each plant is kept at the same temperature, humidity, and given water according to its demand. In addition to data on the plant's condition, temperature, humidity, and demand for water, the days required for callus growth formation at the graft site is recorded.

Experimentation showed the plants exposed to 24 hours of light per day began callus growth earliest (after 9.5 days). Plant groups C, B, and A then finished, respectivley. The total number of lighted hours until the plants began callus growth was averaged at 236 hours, with a variance of 10%. A statistical study of the data showed it to be 90% accurate.

Light exposure per day and the amount of time until callus growth begins at the graft site on Hibiscus rosa-sinensis plants are inversely proportional. Therefore, this plant is not stunted by constant light exposure and can use the extensive amount of light energy to grow at a faster rate.

#Third Award - General Motors ISEF

ACID RAIN; CAUSE AND EFFECT

Healey, Jacqueline A., Skyline H.S., Salt Lake City, UT 84109
3351 Metro Way, Salt Lake City, UT 84109

Acid Rain is a fairly new international problem. Plants, man-made objects, and especially aquatic life have been affected. The experiment I conducted dealt with the effects of acid rain on young plants.

The hypothesis that I formulated was plants being watered with low pH values (approximately 1.5 - 4.5) would: (1) have stunted growth; (2) fail in capability of photo synthesis; and (3) appear unhealthy and have a lower chance for survival.

Using schefflera plants, recommended by a florist because of the close characteristics to undergrowth plants, precipitation of several pH values was added to the plants to create as close to a natural rain environment as possible. Nitric acid was used for the acid component in the rain.

Each day, the plants were monitored under light for eight hours and watered. I used a daily log and noted changes that I observed.

Results of this experiment were obtained within a few weeks. Plants with lower pH values were considerably smaller than those of higher pH or the controlled plants. The leaves of the low pH plants were lighter in color and duller in shine. The low pH plants appeared unhealthy while the higher pH plants were maturing normally.

The conclusions that I made after conducting this experiment were close to my predictions. The survival of plants will lessen with low pH precipitation. Photosynthesis capability is diminished and growth is stunted. Acid rain may be extremely dangerous by altering the balance of an ecosystem.

STUDY OF THE EFFECTS OF EDB AND SUCROSE ON NEMATODA & N-F BACTERIA

Black, Clinton Leander, Marianna High School, Marianna, FL 32446,
800 Booker Street, Marianna, FL 32446

Ethylene dibromide has been used for decades in Florida in a variety of ways, but solely used as a gasoline additive. Much of the E.D.B. produced in the United States is also used as a nematicide. Because this chemical evaporates quickly and does not readily dissolve in water, it was not considered likely to become a problem in drinking water. However, in the past few years Florida and several other states have discovered E.D.B. in well water. After a few contaminated wells were found near treated sites, the Enviromental Protection Agency (EPA) immediately suspended E.D.B. as a soil fumigant for nematodes. Temik was chosen as an alternative for E.D.B.

In this research project, I will expose Ethylene dibromide vapor to nitrogen-fixing bacteria to determine the effects E.D.B. have on nitrogenfixing bacteria when being exposed to nematoda in the soil. During my research I will also conduct experiments to determine if sucrose can substitute for E.D.B. and Temik without harming the nitrogen-fixing bacteria, the legume plants and most important the public's health. I will further my research by placing Xylene, Carbon Tetrachloride, Benzene and Chlorodenze bath under the Ethylene dibromide to control the E.D.B. vaporizing rate with Liquid Nitrogen.

EVALUATION OF SOURCES OF PHOSPHORUS IN EUTROPHICATION OF A LAKE AND NUISANCE ALGAE GROWTH

Hunter, Wally W., Milton District H.S., Milton, Ontario, Canada, L9T 2G4.
93 Victoria Street, Milton, Ontario, L9T 1S6

Using levels of phosphates common to Lake Simcoe (located north of Toronto, Canada), an experiment was conducted to determine the effect of phosphate levels at non-point sources and their effect on the growth of the algae cladophora. The experiment showed that phosphorus from specific areas of the lake at varying concentrations was a limiting factor for the growth of cladophora. Many methods of pollution control were also researched. It logically follows that the instalation of sewage treatment plants at local sites, draining into the lake, regulated at specific phosphate levels, will cause increased cladophora growth and thus eventually eutrophication.

The experiment determined that the effects of varying concentrations of phosphates at point and non-point sources caused progressive growth of cladophora in excessive quantities.

A POSSIBLE MICROBIAL DEGRADATION OF GLYPHOSATE

Caruthers, Shelton D., Cedar Creek H.S., Ruston, LA 71270;
430 Forest Circle, Ruston, LA 71270

The purpose of this experiment was to isolate microbial growth which not only breaks down glyphosate (Round Up herbicide) but also utilizes it as a carbon source. Into a carbon-free mineral salt solution was placed 1g soil from either a cotton field, a soybean field, or a control area (no herbicide treatment). Varying amounts of glyphosate (0ppm, 50ppm, 500ppm) were added to the samples, and each beaker was placed on a shaker. After four days' growth, spectrophotometer readings were made to test for turbidity. The controls had more transmission at 505nm than the tests, thus suggesting the presence of growth in the tests.

From each of these solutions, 5ml of liquid were innoculated on petri dishes with corresponding amounts of glyphosate. The slides which were later made from transfers of these dishes indicated some microbial growth was utilizing the glyphosate as a carbon source. This growth, which was not present in control dirt, must be a result from the changed flora of these fields.

Both the effects and the uses of this microbe are unlimited. Its presence could be either a good or a bad effect on the composition of the soil. This microbe might also be used in some way to control the effect of glyphosate on both plants and the environment.

DENDROCHRONOLOGY: EVIDENCE OF RECENT AND HISTORICAL POLLUTION

Hodges, Ty A., East Jr. High School, Ponca City, Oklahoma 74601;
79 Ranch Drive, Ponca City, Oklahoma 74601.

I wanted to see if dendrochronology could be used to determine lead concentrations for past and present times. I took increment bore samples from pine trees and measured the amount of lead in 5-10 year increments. The trees showed an increase in lead as the tree aged, except for the last five years in which the lead dropped.

I found out dendrochronology can be used for determining lead concentrations both recent and past.

One would need to test many trees to get reliable results.

ANOTHER CONTRIBUTION TO ACID WATER CONDITIONS

Carr, Jennifer L., Lecanto H.S., Lecanto, Fla. 32661
5275 S. Chestnut Terrace, Lecanto, Fla. 32661

The purpose of this 2 year study is to investigate the problem of: Will coal pile storage contribute to acid water conditions in ponds and lakes?

My hypothesis is: Coal pile storage will contribute to sulfuric acid leaching into underground water streams.

The procedure was: The first year to take washed and unwashed coal and test them for pH in the laboratory. I obtained the amount of rainfall and tons of coal burned for the year. This year, I tested wells located around the power plant property for pH as well as conductivity. I collected local rainfall for the months wells were tested.

In conclusion I have found my research supports my hypothesis. In the laboratory both washed and unwashed coals indicated sulfuric acid can be leached and depress the water pH. Through mathmatics I found there is a 5189 to 1 probability a coal pile will leach sulfuric acid. This years research conducted in the field supported my finding of last year. Comparisons of the upstream wells with the downstream wells showed a pH difference of .32 for August. For October (a month with far less rainfall) the pH was still .12 less. The conductivity showed a difference in August of 2.77 x 100 mmhos/cm^2 and supports the theory that ions were leached from the coal pile into the ground water. The same case for conductivity is evident in October.

#THE ECOLOGICAL SYSTEM OF THE PEDIOCETES PHASIANELLUS

Miller, John C., West Fargo Public School, West Fargo, ND 58078;
501 West River Road, Horace, ND 58047.

Problem is the shrinking grouse population in Pierce and McHenry Counties as indicated by the decline in active dancing grounds. Are predators the cause? Is habitat loss the key? Are there other factors?

Method: read and study material, interview people, and study first-hand the entire ecological system of the sharp-tail grouse by obtaining permission, setting up a blind, trapping and putting radios on 4 birds, monitoring them, studying their vegetation and habitat preference with a Robel pole and identification of species, and documenting my research.

Summary of results: 1. Habitat useage is determined by measuring and identifying the vegetation where the grouse nest and raise the young. Dense vegetation is preferred. 2. Within that habitat, the ecological cycle involves a complicated inter-action of the grouse with its natural enemies(which claim 72% of the grouse within a year), with insects, especially when a grouse dies, with the soil and water, with vegetation both above and below the soil, and with grasshoppers, a main food. 3. Food useage is determined by monitoring the birds and noting where they spend their time feeding - dense vegetation is the key to their daily movements. Crop studying verified adaptability to farming; chicks main diet in the summer is grasshoppers.

Conclusion: Lack of good habitat for nesting and brood rearing requires more cooperation between ranchers, farmers and game management people.

#Third Award - General Motors ISEF

STUDYING THE EFFECTS OF ACID RAIN ON THE ENVIRONMENT USING SIMULATED ACID RAIN

Self, James L., Box 27, Stringtown, OK 74569
Stringtown High School, Stringtown, OK 74569

This project is a four-year continuous study of acid rain and its effects on the environment. It started out with a research of literature, progressed to aquatic animal studies, then to plants, and finally to non-living building materials.

I used four types of siding found in our area, two types of pipe, and concrete and brick. I cut seven pieces of each as close to the same size as possible, weighted, placed in pre-labeled acid water bottles. I took the pH every 12 hours. I ran all tests for 48 days. I recorded observations and weighed for weight loss.

The concrete was affected the most. It is crumbly as if it became unglued. Also, the asbestos siding had fibers floating in its water. The aluminum siding got a white residue buildup on its edges, and the steel siding's paint got bubbly and flakey. Also, the edges started to rust. The copper pipe got a pretty red color. The ones the acid seemed not to bother was the vinyl siding, PVC pipe, and brick.

My county water study showed a drop in pH after a drought, with the pH rising as the limestone acted to neutralize the acid. This was consistent with other research.

My plant groups after three years, show below pH4, shriveled stems protruding veins, yellowish and wrinkled leaves, and lesions on the leaves. Most minerals have been leached from the soil. My study shows that after prolonged exposure to acid rain, plants most definitely are affected.

IONIZING RADIATION + ENVIRONMENTAL IMMUNOSUPPRESSANTS= FATAL HYBRID FORMULA

Chuck, Evan Y., Caddo Parish Magnet High School, Shreveport, LA
310 ALBANY Avenue, Shreveport, LA 71105

The culmination of approximately four years of research, this project attempts to demonstrate the synergistic effects of ionizing radiation and environmental immunosuppressants upon the immunological systems of CD-1 SPF mice, specifically the capabilities of leukocytes and the antigen-antibody reactions. At the 34th ISEF, Phases I, II, and III of the project were completed and exhibited, demonstrating the lymphocytic leukocytosis that occurs immediately after radiation exposure at both 400 and 200 RAD. After this preliminary investigation, a phase IV was put into action, which is identified by the current project title. It has been shown that certain forms of chemicals found commonly in man's environment may actually be impairing the immunologic of the human. Such substances have been widely exposed by the media and include such substances as dioxin, PCB's, and even glucocorticoids administered to cancer patients before chemotherapy treatments. Exposure to these substances may actually be contributing to a patient's mortality by weakening the immune system. This compound by radiation exposure, such as from cobalt gamma teletherapy treatments as well as low-level radiation from nearby radiation sources such as nuclear plants or dumps may cause fatalities as found with several of the CD-1 SPF animals. Further research leads to a phase V, which may involve the long range effects of low-level radiation coupled with environmental immunosuppressants upon not only the immediate animals, but also upon succedding generations of CD-1 SPF mice.

#First Award - General Motors ISEF

TOXIC SOLVENTS IN THE SCHOOL ENVIRONMENT

Hill, Jennifer R., Dillingham High School, Dillingham, Ak
Box 10223, Dillingham, Alaska 99576

PROBLEM: Unknown to us, many toxic substances may exist in our public buildings. People may become ill and not know why because of these elusive dangers.

Many schools use porcelain coated steel boards and dry erase marking pens that dry immediately upon contact. The dry erase pens most commonly used are Weber Costello Contesoo and Expo Dry Erase Markers. According to their manufacturers, these markers contain ketones, esters and alcohols as solvents.

The Dillingham High School and other Alaskan schools use dry erase markers. Is it possible that the solvents in these pens can cause health problems in their primary users, the teachers? A questionnaire was sent to 55 Alaskan schools to determine pen usage and noticeable affect on the teachers. There were 19 replies, 38 percent of the schools that use the pens reported adverse side effects possibly caused by the pens. A survey was sent to twelve teachers in the local school. Of the nine replies, 33 percent noted disorders possibly caused by the pens.

HYPOTHESIS: Ketones present in dry erase marking pens may be airborne and absorbed into the blood stream of those in breathing range of the pens.

METHODS/RESULTS: Four blood tests were taken to mark the level of ketones in the blood, all showed no positive level.

An organic vapor monitor badge was worn by a teacher who uses only dry erase pens. After four hours of exposure, the badge was sent to a lab for a gas chromatograph analysis. The badge was tested just for methyl iso-butyl ketone (MIBK.) The analysis revealed 3.0ppm of MIBK by volume. OSHA's accepted limit of MIBK is 100ppm, and even though the level indicated by the badge was much lower than this limit, further research should be done to see if humans may suffer from chronic damages from pen exposure.

SOME ASPECTS OF ECOLOGY AND BEHAVIOUR OF A MALLARD POPULATION IN A DEFINED SANCTUARY AREA

O'Connell, John, Rockwell College, Cashel, Co Tipperary, Ireland
St Anthony's Villa, Park Road, Killarney, Co Kerry, Ireland

In recent years Irish Gun Clubs and individuals throughout the country have established wildfowl sanctuaries, often working in conjunction with the Irish Wildlife Service. Due to shooting pressure during Autumn and Winter and a gradual erosion in natural habitat resulting from land reclamation and drainage, increasing numbers of mallard are to be found in these sanctuary areas. Enormous numbers can be found on some inland waters and they are joined in Winter by other species of migrant duck. Little work has been done in Ireland in assessing sanctuary productivity. This project attempts to investigate levels of breeding success with particular emphasis on predation, as there is little control of either avian or ground predators in newly defined sanctuaries. Equally, since Irish sanctuaries are becoming increasingly popular for recreational pursuits, eg boating, fishing, water skiing, there is an urgent need to assess the effects of the resulting disturbance on mallard populations.

Specifically the project investigates:

- Selection of nest sites and breeding success levels.
- Level of nest and duckling predation.
- Disturbance.
- Analysis of bag returns of local sportsmen as an indicator of age distribution in the Autumn population.
- Behaviour of mallard species.

The project also considered the effects of such environmental factors as temperature and insect availability on duckling survival in relation to breeding success levels.

#First Award - General Motors ISEF

#EFFECTS OF NOISE A TWO YEAR STUDY

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It is commonly accepted tha noise affects our mental and physical health. This research determined what components of noise causes the health problems.

Year one determined that pitch lowered blood pressure therefore, not a cause of health problems. Year two tested forty people with normal hearing and fifteen people with an hearing impairment to determine if there is a difference between ambient and white noise and the effect on the test subjects' physical health. The participants were exposed to five minutes of white noise and five minutes of ambient noise with two controls tests, while their pulse rates, respiration rates, skin temperatures and blood pressures were monitored on a computer.

The ambient noise did not affect the heart rates or the respiration rates in either group. However, the ambient noise caused a significant elevation in the skin temperatures of the hearing impaired group, and the diastolic pressures of the hearing group. The ambient noise also significantly raised the systolic pressures in both groups.

The heart rates and the diastolic pressures were not affected by white noise in either group. The respiration rates were significanly raised by white noise and the skin temperatures were sinificantly lowered in the hearing group. The skin temperatures and systolic pressures were raised by white noise in the hearing impaired group.

Although the statistical analysis of the data shows no significant change in the heart rates during the ambient noise the graphs show large fluations in the heart rates of both groups.

#Second Award - United States Air Force

Honorable Mention - Acoustical Society of America

BURNING PAPER-IS IT HAZARDOUS TO YOUR HEALTH?

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The enormous mobilization and use of heavy metals like lead, cadmium, molybdenum and mercury in technologically advanced countries has resulted in increased contamination of the environment with these metals. Much recent research in the USA has been directed at assessing the impact of lead from automobile exhaust on public health. This project addresses the basic question: Is the lead content in colored paper and newsprint significant enough to cause concern when combusted? Spectrophotometry using a dithiozone method was used in this project due to its extreme sensitivity and rapid extraction method of the pink lead complex. An analytical procedure by the HACH company for water and wastewater was modified and used for this project. Paper was masses on an analytical balance and burned in a system vented into a flask of lead-free water. The contaminated water was tested for the presence of lead by using a HACH DR-EL/1 spectrophotometer. Three samples of 15 different colors or types of paper were tested; the results averaged together to make composite results. This project found that solid, gold color paper possessed more than 150 mcg of lead per gram of sample; whereas, plain white paper contained no measureable lead. Thus, burning paper that is colored or at least has ink on it does pose a health hazard.

NEAR SHORE WATER QUALITY STUDY OF AREA LAKES - A SURVEY OF NEAR SHORE WATERS IN BECKER COUNTY OF LAKE SALLIE, BOYER, LONG LAKE AND LAKE LABELLE

Wallace, Melody C., Lake Park High School, Lake Park, Mn 56554
Lake Park, Mn 56554

This project deals with the studying of the differences and similarities of chemical content of area lake waters. I chose two lakes with human populations and activities around them (Lake Sallie and Long Lake) and two lakes with little or no populations and activities (Lake Boyer and Lake Labelle). I compared water samples by testing for hardness, dissolved oxygen, pH levels, silica, nitrates and phosphates, and carbon dioxide content.

I used the standard water tests provided by the Lamotte Chemical Company. After collecting the test data, I graphed and compared the results.

From the data collected, I concluded that the oxygen content increases with increased depth. As the oxygen content rose, carbon dioxide content decreased. The hardness of the water is increased by ground water runoff. Increased silica levels seem to be related to the amount of runoff, erosion and number of inlets and outlets.

Overall, the lakes studied contain the chemicals and range of concentrations similar to those found by others testing similar lakes under similar conditions.

STUDY OF THE PRESENCE OF HEAVY METALS AND PATHOGENIC BACTERIA IN CRASSOSTREA RHYZOPHORAE

Ramírez, Aixa I., CROEM, H.S., Mayaguez, P. R. 00709;
Box 56-A, Boquerón, Puerto Rico 00622.

This study was performed to detect the capacity of Crassostrea rhyzophorae (oysters) to retain toxic metals and pathogenic bacteria. Samples were collected from different areas of the Boquerón Bay and were analyzed in the laboratory. Atomic absortion methods were used for the detection of heavy metals. The content of the heavy metals present were determined with an Atomic Absortion Spectrophotometer. The heavy metals detected were Cadmium, Mercury, Lead and Arsenic.

Through the experimentation the researcher demonstrated that Crassostrea rhyzophorae is capable of retaining significant levels of heavy metals. Samples showed that levels of lead and Cadmium were superior to E.P.A. values.

Searching for the coliform Escherichia coli in the oyster also were made and all the samples showed a positive response.

The results of this research suggests that people who consume oysters from the collected area could be poisoned.

SELENIUM: A HIDDEN ENEMY

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Water pollution is a subject that invites wide general discussion; few people know how to define or measure it or have any idea to what extent it may be tolerated. As a trace element, selenium is necessary to health; but it is poisonous when highly concentrated; and in some places, California agricultural practices seem to have developed such concentrations. The problem developed in this investigation involved the use of a simple green algae, Spirogyra, which is a common free floating algae in freshwater environments, as a target agent for the reduction of selenium in selenium polluted waters. Mass spectrographic analysis showed reduction of selenium in Spirogyra rich environments, in contrast to control. Biological support evidence confirmed reduction of selenium in the contaminated environments.

#THE EFFECT OF CHROMIUM(III) ON MICROBIAL BIOCONVERSION WITH AN APPLIED SLUDGE AGRICULTURAL STUDY

Thompson, Marilyn S., Central H.S., St. Joseph, MO 64501
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Trivalent chromium flows into the St. Joseph, Missouri, waste treatment plant in larger than normal concentrations due to the wastes of Blueside, a local leather tannery. In the first part of this research, anaerobically and aerobically treated sludge from the local treatment plant was analyzed for heavy metals and microbial life using Inductively Coupled Plasma Spectroscopy and the ultraviolet detection of adenosine-5'-triphosphate (ATP). Samples of both sludge types were spiked with increasing chromium concentrations while monitoring the presence of ATP (it is a product of respiration). Chromium was found to be detrimental to the microbes at about 60ppm in the anaerobic stage, which is slightly higher than the EPA maximum standards.

When sludge is applied to the land farms, it presents an additional hazard. Industrial sludge form Blueside was analyzed for chromium and available nitrogen content. The cation exchange capacity of a yard soil and a commercial potting soil was also determined. With these factors known, it was possible to calculate the maximum level of chromium (based on the nitrogen requirement) which can be applied to a crop soil in the sludge form. A comparison of wheat and corn crop circumstances showed that a significantly larger amount of chromium could be applied to a corn crop field.

#Second Award - Water Pollution Control Federation
Third Award - General Motors ISEF

DISTRIBUTION AND IDENTIFICATION OF BROMELLACEAES DELONIX REGIA

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Buzon: Barrio Cedro Arriba, Naranjito,PR 00719

Delonix regia (Flamboyan tree) is a native tree of Madagascar been one of the ornamental trees most widely cultivated in tropical and subtropical regions. It grows everywhere in our island, especially in the border of the roads, probably been the most widely admired tree for its leafy foliage and beautiful blossom. One thing we can easily observe about this tree is that it is host of many bromelleaces. The purpose of this reseach is to identify the bromelleaces species that are developed in this tree, to observe its distribution and to relate them with the height and diameter of the tree in two zones between Naranjito and Bayamon and between Aibonito and Coamo. To do this a sample of 100 flamboyan trees were taken in each zone and the species and number of bromelleaces/tree were identified and counted. The location of the bromelleaces in the tree and the height and diameter of the tree were also determined. The results showed in the area of Coamo there are more species (7) than in the Bayamon area (5), although in both areas the prevailing specie is Wittrockia superba (75.38% in Bayamon and 49.72% in Coamo). However in the Coamo area there are other species that are abundant like Greigia sphacelata and Vrisca Favorite. Also the number of bromelleaces/tree is more in the Coamo area (21 bromelleaces per tree) than in the Bayamon area (15 bromelleaces per tree). In addition, the results showed that these species are located in the high and intermediate areas of the trees. In most cases the tree is the keeper or host of only one specie of bromelleaces. There is a great difference in the number of bromelleaces in the two areas due to difference in climatic conditions.

MAKING POLLUTED WATER SUITABLE FOR LIFE THROUGH ELECTRO-CHEMICAL WATER CLARIFICATION

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My purpose was to take polluted water from the environment and clarify it through Electro-Chemical Water Clarification making it suitable for life. In order to prove the water's suitability for life after clarification, I tested pH and water clarity percentages. After these tests I used plants and brine shrimp to show that the water actually could support and promote life.

I first researched water pollution and this type of water clarification. I then took 48 polluted water samples from the environment and treated them with this system, testing the pH and water clarity before and after. Next to see the effect on life, I performed experiments using seeds, testing their growth ratio, and brine shrimp, testing the kill ratio. I found that the process lowers the pH of water because of a chemical added. I found that life exists at neutral pH but can also survive in some alkaline or acidic substances. My conclusion is that Electro-Chemical Water Clarification is an effective and environmentally safe procedure, which can be used to make polluted water suitable for life.

ASPHALT BASED ROAD MATERIALS AS A FLY ASH DISPOSAL MEANS

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Fly ash is a powdery material that is produced when pulverized coal is burned with forced air. With the increased use of coal in the United States, the disposal of this waste product has become a major problem. Fly ash production may reach 88 million tons by 1990. My hypothesis was that fly ash could be disposed of by adding it to asphalt based road materials without harming the strength of these materials or their high or low temperature characteristics.

Fifty-six samples of asphalt paving material were prepared. The composition of the control samples was the same as that of paving materials currently used on roadways; while the other samples contained fly ash as a replacement for part of the sand that is used as a mineral filler in asphalt paving material. All of the samples were pressure tested. Prior to pressure testing, some of these samples were placed in the oven and heated from 60°C to 100°C in ten degree increments. Others were cycled from 23°C to -8°C, 15 times before pressure testing. The remaining samples were pressure tested after simply being stored at room temperature.

The samples with 33.3% fly ash for the mineral filler withstood 2.5 times more pressure than the regular paving material. My research confirmed that the addition of fly ash to asphalt will provide a useful means of disposal of this waste product and at the same time, produce improved road paving materials.

#First Award - American Society of Civil Engineers
First Award - United States Air Force
First Award - U.S. Department of Energy
Fourth Award - General Motors ISEF

HOW ABANDONED COAL MINES ARE A HAZARD TO OUR WATER SUPPLY

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Reclaimation is without question the slipperiest word used in strip mining. It means to the mine operator simply pushing and smoothing the overturned earth. But to the landowner of unproperly reclaimed land, it means contaminated water making it dangerous for livestock and wildlife.

The purpose of this project is to inform people of just how big a problem our abandoned coal mines really are. The damage strip mining does is much larger in comparison to its benefits.

The research began with water samples being analyzed by a laboratory. Some pictures were taken of the wash pits overflowing into ponds and streams with dead fish lying along the banks. The seriousness of this problem is very apparent. Letters have been written, telephone calls have been made, trips to Oklahoma City, departments notified; but as of this date, no action has been taken to correct this problem.

It is not understood why money can be spent on mining the land, and yet nothing done about putting the land back properly so this problem of pollution would not exist. Presently, by leaving these abandoned coal mines unfinished, trash dumps are provided for many.

This is a problem that needs to be recognized and corrected before the damage is irreversible.

#THE EFFECTS OF SPECIFIC $Pb(C_2H_3O_2)_2 \cdot 3H_2O$ ON THE ERYTHROCYTES OF CARASSIUS AURATUS

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The effects of specific $Pb(C_2H_3O_2)_2 \cdot 3H_2O$ on the erythrocytes of Carassius auratus were observed in order to determine the change in number and structure of erythrocytes of goldfish in various concentrations of $Pb(C_2H_3O_2)_2 \cdot 3H_2O$.

Sixty goldfish were purchased and divided equally among five (3.5 liters each) containers. In a flask, 400 ml of H_2O, two drops of anti-chlorine, and 0.029g of $Pb(C_2H_3O_2)_2 \cdot 3H_2O$ were added. From this the specific concentrations were diluted. The atomic absorption spectroscopy process determined the initial lead concentration to have been 5000 ug/l.

Ten fish were sequentially sacrificed each seventh day, during a four-week period.

The red blood cell counting was performed through the use of a red blood cell diluting pipet, an anti-coagulant, Haymen's solution, distilled H_2O, and HNO_3. The red blood cell counts were recorded while blood smears were made and then preserved for later photomicrographic analysis.

The erythrocytes of gold fish proved to change in number and morphology in each specific concentration of lead acetate. The linear interpolations suggest that the number of RBC's were directly related to the increased lead content. This experiment indicated a structural change in the RBC's of goldfish and is evident from the photomicrographs.

#First Award - American Medical Association
Third Award - General Motors ISEF

TRAPPING, HOW IT EFFECTS MAN AND THE ENVIORNMENT

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The purpose of this experiment has been: To see if trapping plays an essential role in controlling the expansion rate and over-population rate of predators, to view the effect of over-population of predators on our environment, the impact it has on man's fur, cattle, and sheep industry and to show man's role in the management of these animals.

I have based my experiment on the following predators: Red Fox (Vulpes Fulva), Gray Fox (Urocyon Cinereoargenteus), Swift Fox (vulpes Velox), Coyote (Canis Latrans), Bobcat (lynx Rufus), Mountain Lion (Felis Concolor).

In my experiment I found that the predator population in the region around Hanksville, Utah (the area in which my project was initiated) is directly proportional to the RA units or the Rabbit Population. My studies demonstrated that there is a need for trapping, and it is an essential element in controlling the population of predators. As man expands into the habitat of the animal kingdom, we crowd together predators and other animals into smaller and smaller regions or quadrants in which they are forced to live. This creates a problem and disease spreads more widely because of the concentrated rate in which the animals are forced to live. I have demonstrated this by showing that the population rate is directly proportional to the disease rate. So it is the duty of man to take care of the enviornment and to see there is a place in the world for all living creatures.

#ACID RAIN: CAUSES, EFFECTS, CURES. A SEVEN YEAR STUDY

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This project represents the culmination of seven years research on acid rain. In this, my senior year, I have added one major step to my project, while continuing wuth research on the other areas. This years project consists of four steps: First, to find the causes of acid rian, second, to find the effects of acid rain, third, to find a method to correct the damage already caused by the acid rain, and fourth, to take all of the previous research and impliment it. This step has alowed me to test my hypotheses on two ponds in the Adirondacks. This researcher has conducted these experiments over the last seven years, with this years main focus being the fourth step of the project.

The fourth step of the project has been to take all the previous research, and incorporate it into practical use. Using the material I found, through previous experimentation, to be an effective neutralizing agent, I began testing it on two acidified ponds in the Adirondacks. After I neutralized the ponds I began restocking them with native plant and fish life. At the time of this report the fish have breed into the eighth generation, and are completely normal. Therefore, I believe I have found an effective way to neutralize acidic lakes, and to bring many dead areas of the Adirondack Park back to life.

This experiment shows the full circle of the acid rain problem: The causes, effects, and cures.

#Scholarship - Ohio State University
London International Youth Science Fortnight - United States Army
Third Award - General Motors ISEF

PHOSPHOROUS DESORPTION FROM THE ARGILLIC, SPODIC, AND SURFACE HORIZONS OF AN ULTIC HAPLAQUOD

de Guzman, Denise D., A.U. Nease H.S., Jacksonville, FL 32224
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Extractable phosphorus from soil samples was measured using the Melich I method in an initial attempt to index phosphorous availibility to plants.

In this enduring, long-term study, the Melich I phosphorous levels in the argillic horizons should differ from the spodic and surface horizons. The natures of release should differ; thus, the availability of phosphorus to plants should differ.

An explanation of the differences in the phosphorous rate of release from the soil horizons is plausible in an attempt to characterize phosphorous desorption.

Using miscible displacement techniques, the soil samples were prepared with a .01 molar calcium chloride solution at a pH of 4.5. The calcium solution was then run through a filter flask apparatus at a rate of one milliliter per minute. The leachate was then run for molybdo-phosphate blue color. Color development was determined on a light spectrophotometer.

A simple mathematical expression formed from the long-term data of this research project could conveniently provide rate constants for ranking soil and minerals according to their ability to release soluble phosphorous to solution.

#First Award - American Society of Agronomy

MICROBIOLOGICAL COAL DESULFURIZATION USING THIOBACILLUS FERROOXIDANS

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Sulfur in coal is released as sulfur dioxide during combustion. Lowering the sulfur content before combustion could ease the acid precipitation problem and could raise the market price of coal. Removal of sulfur in coal using microorganism (MDS) has advantages over mechanical and chemical processes.

The bacteria and coal were obtained from the University of Oklahoma. Twenty-five grams of coal was placed in each of four one-gallon jars with one liter of water and one liter of the medium. One hundred milliliters of the bacteria and medium was inoculated into three jars with one uninoculated jar being the control. An air pump per jar supplied air and agitated the mixture.

Tests for total sulfur content were taken at one-week interval. Total sulfur content was determined by the Eschka method according to the Standard Test Methods for Total Sulfur in the Analysis of Coal and Coke. Seven tests per jar were carried out.

Final total sulfur removal rate was 96% from coal samples containing 11% total sulfur. A 100% removal rate is impossible because this microorganism is incapable of removing organic sulfur compounds in coal. There was an increase in the removal rate between the first and second week of tests; there was also a slowing down in the removal rate. Both results were expected. The curve correlated with bacterial growth. There was no sulfur removal in the control reactor.

At this moment, many factors contribute to the infeasibility of applying MDS into actual coal preparation processes. Perhaps when the price of coal increases, the application of MDS will be possible and profitable.

#First Award - American Indian Science and Engineering Society
First Award - U.S. Department of Energy

THE EFFECT OF LEAD COMPOUNDS ON THE OFFSPRING OF DROSOPHILA MELANOGSTER

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To find out if lead compounds could cause fertility problems or mutations in animals,wild type Drosophila melanogaster were placed into vials containing media with different concentrations (1:100, 1:1000,1:10000,1:100000) of lead sulfate, lead oxide or lead chloride and their off-spring (F-1 generation) examined for known mutations and abnormalities. The F-1 flies were placed into lead-free media and their offspring (F-2 generation) were examined for mutations and abnormalities. The lead oxide reduced the number of offspring by 70% as compared to the control vials. The lead sulfate reduced the number of flies 35-40% in both generations compared to the control and produced known mutations and abnormalities in all of the concentrations in both the F-1 and F-2 generations. Lead compunds could be causing fertility problems and mutations in humans.

#Fourth Award - General Motors ISEF

CAN DANDELIONS BE USED TO INDICATE LEAD POLLUTION?

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The purpose of this project was to determine whether dandelions could be used as a simple indicator of lead pollution in soil. Samples collected from various locations were washed and chopped, extracted with nitric acid, and their lead content analyzed gravimetrically. Results revealed that the dandelions did reflect, with greater than ninety percent accuracy, the lead pollution near busy highways. The highest level of lead (785 ppm) was found on an elementary school playground located by the intersection of two heavily traveled interstate highways. Further investigation into possible correlations between this high lead level and the academic performance of students at this school would be of interest.

THE EFFECT OF AQUATIC PLANTS IN TREATING MERCURY COMPOUNDS IN WATER

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An experiment was conducted to determine the effect of aquatic plants in treating mercury compounds in water. It was hypothesized that the aquatic plants would reduce the concentrations of mercury in the water.

The aquatic plants, Elodea densa, Dracaena sanderiana, and Ophiopogon japonicus, were placed in various concentrations of mercury nitrate in 1000 ml water to determine the effect on the concentrations of mercury. The test for presence of mercury was conducted after 24 hours on all plants. All results were positive. Tests for observing enzyme reaction inhibition were conducted six times on all plants.

It was found that, as time progressed, the percent enzyme inhibition increased. It was concluded that aquatic plants do reduce concentrations of mercury in water. If industries have wastes containing heavy metal poisons, treatment pools using aquatic plants may be useful in solving this problem.

DOES CITRUS PEELING EXTRACT AFFECT THE LIFE CYCLE OF DROSOPHILA ?

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124 Thayer Ave., Mankato, MN. 56001

Wild, white eye, vestigial and ebony strains of Drosophila were maintained at the same temperature 70°F or 25°C for the entire experiment. Light was regulated with a timer at 12 hours of light and 12 hours of darkness. Citrus fruit peeling extract was mixed with the media in 100%, 75%, 50% and 25% concentrations. Twelve males and twelve females were initially established in each trial vial. Three vials were set up for each trial. The three citrus fruit types used in the experiment were orange, lemon and grapefruit. Citrus fruit peeling extract was used in lieu of tap water. Controls were maintained under the same conditions without citrus fruit peeling extracts. In addition to the above series, an additional series was performed where one drop of 100% citrus fruit peeling extract was placed with the aid of a micropipette on the dorsal side of the thorax of each individual wild type Drosophila. Each of these flies were maintained in a vial containing normally prepared media. Three test vials each containing one fly was used in each trial. Observations of the above trials indicated that the citrus fruit peeling extract does cause a change in the life cycle of the Drosophila. The lethal effect was very obvious when the 100% extract was applied to the dorsal side of the thorax of individual wild type flies. The observed lengthening of the life cycles was observed in all the extract concentrations when and if the flies did breed and reproduce. Lethal effects of the citrus peeling extracts mixed in the media was reduced as the concentrations of the extract used was reduced from 100% down to 25% with all four strains of Drosophila.

THE HERBICIDAL CREOSOTEBUSH: RELATIONSHIPS WITH SEEDS, TEMPERATURE, AND CANCER

Gordon, Mark Robert, Central High School, Phoenix, Arizona 85012; 5637 North 13 Drive, Phoenix, Arizona, 85013.

The creosotebush (Larrea) exudes herbicidal toxins that prevent other plants from growing near it. When in competition for existence in the desert, it uses its toxins to secure necessities.

Six tests were conducted with this plant. Germination rates of coated and hulled Sonoran and Chihuahuan creosotebush seeds were compared. Through experimentation, the optimum germination temperature was found for coated and hulled seeds of both species. Varying sized cuttings of the plant were taken to determine if this is a fast means of propagation. The effects that the leaves and twigs and the carpels of the creosotebush on various outdoor plants were found.

In my research, I have found that the Chihuahuan species of creosotebush seeds have a higher germination percentage than does the Sonoran species. When these seeds are hulled, however, the Sonoran seeds yield higher germination results than do the Chihuahuan seeds. By hulling the seeds, I have come to find that germination rates are greatly enhanced. I have proven that cutting the creosotebush is a successful method of rapid reproduction. I have also found that creosotebush leaves and twigs have a devastating effect upon notocactus species, Anaheim chili hot pepper, and petunias and that creosotebush carpels also have an effect upon the plants.

In my library research, I found an Environmental Protection Agency document declaring that the creosotebush might be cancerous. Their research, however, proved inconclusive.

In sum, my research examined relationships of the creosotebush to the environment around it; thus, "The Herbicidal Creosotebush: Relationships with Seeds, Temperature, and Cancer."

#Fourth Award - General Motors ISEF

A STRUCTURAL STUDY OF A FRINGE MANGROVE AND DECOMPOSITION OF RHIZOPHORA MANGLE (L.) AND LAGUNCULARIA RACEMOSA (L. GAERTNF) IN JOBOS, PUERTO RICO

López, Lynbette, Adolfo Grana Rivera H.S., Fortuelas, P.R. 00726; Box 475, Guayanilla, P.R. 00656.

Nutrients recyclin in mangrove forests occurs principally through leave fall and decomposition. Leaves are the tree components that are lost from the trees to the environment in the highest relative proportion and frequency, as evidenced by the crops found on the forest floor. The objective of this study is to determine the rate of decomposition of the different mangrove species. For this study a mangrove fringe was chosen in The Jobos Bay National Estuarine Sanctuary. The following questions were presented to be investigated: 1) What is the diversity, density and frequency of mangrove species? 2) What is the leave's decomposition rate for a transect of 10 x 100 m (0.1 /ha) representative of the study area.

Trees of diameter greater than 1.0 cm were measured and identified by species. Density and relative abundance was then computed. The dominant species is Rhizophora mangle with 5740 individuals per hectare and basal area of 8.0 m^2 /ha. There were 1510 ind/ha of Laguncularia racemosa with basal area 4.8 m^2 /ha. Avicennia germinans was less abundant in the transect. Fresh leaves of the two dominant species were placed in 1 mm^2 pore size mesh bags of 10 cm x 20 cm area. Bags were loaded with 10g of fresh leaves and placed on the forest floor. Six replicate bags per species were retrieved for residual dry weight determination at progressively larger time intervals (0, 2, 4, 8, 16, 32, 64, 128, 256 and 512 days). From these data the rate of decomposition as a function of time was determined.

CYTOTOXIC AND MUTAGENIC EFFECTS OF VARIOUS ASBESTOS FIBERS ON IN VITRO MACROPHAGE CELL CULTURES

Sudia, Robert J., Fitzgerald H.S., Warren, MI 48091
21407 Curie, Warren, MI 48091

Asbestos is present across the entire spectrum of our environment — in our air, water, food, and drugs. Because the exact nature and mechanism of cellular reaction to such asbestos is not known, it was the purpose of this study to examine the effect of various asbestos fibers on developing cell populations.

In vitro cultures of mouse monocyte macrophages, yeast cells, paramecium, euglena, or Artemia were exposed to .015 cm^2 or .63 cm^2 of five major types of reference samples of asbestos (Chrysotile, Crocidolite, Serpentine, Anthophyllite, and commercial), cotton, or glass fibers. All environmental factors and media contents were very carefully controlled. Population density and mutagenic features were identified for each cell culture at various time intervals.

Since the initial in vivo response to asbestos involves uptake by host macrophages, statistical analysis focused on how the physical and chemical features of the various asbestos types effected this cell line. A direct relationship between friability of the asbestos and its toxic nature was statistically significant ($\alpha < .05$). Although correlation is not proof of causation, increased levels of asbestos' magnesium ionization resulted in increased macrophage cytotoxicity. While asbestos was toxic to all cell lines examined, the control fibers of cotton and fiberglass were not. Accordingly, this project isolated the physical and chemical characteristics of asbestos which would be most hazardous to tissue forming cell lines.

#First Award - American Medical Association
First Award - General Motors IESF

THE BEHAVIORAL EFFECTS OF ACID PRECIPITATION ON DUGESIA TIGRINA

Zenk, Brenda M., Henry Sibley H.S.,West St. Paul, MN 55118; 1184 60th St. W., Inver Grove Heights, MN 55075.

This study tested the behavioral effects of acid rain on a type of Planaria, Dugesia doratocephala, using the hypothesis that the lower the pH of the solution down to the lethal point, the more the behavior of the Planaria would be affected. Since Planaria are fairly low in the food web, if they are killed by acid rain, other animals in the food web, even all the way up to humans, will be affected.

Using a 10% concentration of sulfuric acid, various pH solutions were made and tested to find the lethal level for the planaria which was found to be about 5.1. Two control groups with spring water (pH 6.0) and experimental groups with pH 5.7 and 5.3 were used. The Planaria's fission rate and feeding behaviors were observed. The Planaria in pH 5.3 underwent fission more often and regenerated more quickly than the control group or the other experimental group. They also ate more than the controls and moved more quickly. These observations seem to indicate that at a lower, yet not lethal, pH level, the metabolism rate increased.

#APPLYING ANALYZATION TECHNIQUES TO COMMERCIALLY-MANAGED FORESTS USING MATHEMATICAL FACTOR ANALYSES

Luthy, Brian M., Black River High School, Sullivan, Ohio 44880
4473J Stewart Road, Sullivan, Ohio 44880

The objective of this project is to develop a system employing mathematical analysis of growth factors in a commercially-managed forest area. This is to be accomplished by performing many initial testings in southern Lorain County, Ohio; then more testings in Findley State Park, Wellington, Ohio. These tests will form the basis of an analysis system, by combining the time-tested techniques of timber cruising with the newly developed mathematical factor analyses system, both of which are used to obtain certain indexes, such as diameter, height, timber volumes, and growth factor deficiencies.

Once an accurate system has been determined, the area of Findley State Park will be analyzed using those techniques described previously. This 1000 acre forest meets the requirements of being commercially-managed, and is a vast area, able to provide accurate and detailed results.

Once data has been accumulated, it will be analyzed in three ways. The first method is used to determine the accuracy of the gathered indexes: diameter, height, timber volumes, and growth factor deficiencies. Several values will be obtained, including arithmetic mean, standard deviation, standard error, and co-efficients of variation.

The second method involves the dividing of the data into management compartments of 200 to 300 acres, and further subdividing these compartments into 10-acre management units.

The third method will be the production of a management system for the entire forest and park's forest area of 1000 acres. By using the compartment/unit approach, individual recommendations may be made, area recommendations may be made, and overall recommendations considered.

#Second Award - General Motors ISEF

THE SELECTION OF HERBICIDE RESISTANCE IN R. LEGUMINOSARUM

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The selection of herbicide resistant strains of Rhizobium leguminosarum was investigated by growing R. leguminosarum in mannitol-nutrient broth which contained a 1% concentration of various herbicides. Every two hours for 8 hours one tube containing bacteria only and one tube containing bacteria and the herbicide was removed from incubation. Dilution tubes were made and pour plates were then prepared using 1 loopful from the last set of dilution tubes.

The plates were then incubated and total plate counts were made to establish the initial growth curve. To establish the existence of herbicide resistant strains of R. leguminosarum, a new set of mannitol-nutrient broth tubes were innoculated from the previous undiluted 8 hour herbicide and bacteria broth tube.

Dilution tubes were again prepared to the rate of 1:100. One loopful was transferred to sterile petri dishes and pour plates prepared. The new plate counts are used to determine a new growth curve.

A comparison of the first growth curve to the second shows a significant increase in the numbers of colonies of R. leguminosarum, which would indicate the existence of herbicide resistant strains of R. leguminosarum.

A STUDY INTO THE EFFECTS OF THE INDUSTRIAL IMPACT ON SELECTED AREAS AND ENVIRONMENTS

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The purpose of my project was to analyze the environment of St. James Parish while conducting several tests on the three phases of the environment: the water, air, and soil. I also have conducted a series of tests on the crawfish and goldfish to determine their tolerance point to several chemicals.

In my experimentation, I obtained soil and water samples from various areas. When analyzing the water for pH, mercury, lead, nitrate nitrogen, phosphorus, BOD, phosphates, fecal coliform, nitrates, cadmium, copper, arsenic, and zinc, all were below the maximum range set by the E.P.A.

In my soil analyses, I found the average CEC and % base saturation to be normal. In my test for potassium, nitrogen, and phosphorus, the amounts present were well within the safe zone.

I used a gas chromatograph to analyze the air in our parish. The total suspended particles, sulfur oxides, carbon monoxides, nitrogen dioxides, ozone, hydrocarbons, and lead were all below the maximum level. I am now in the process of analyzing the water and soil near radioactive waste dumps for alpha, beta, and gamma particles.

In my last test, I found that the crawfish and goldfish both had an average tolerance point of 11,000 grams acid per 1,200,000 grams of water. (Simulated acid rain effects)

In conclusion, St. James Parish is sufficiently within the maximum range of chemical pollutants. The industries in our parish also have sufficient waste monitoring equipment used for protecting the environment.

#First Award - American Society of Agronomy

ACID RAIN:A STUDY OF ITS EFFECTS ON MICROORGANISMS

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Acid Rain has become one of the most insidious environmental hazards of our times.It has led to severe degradation of many aquatic ecosystems.

In the delicately balanced aquatic food chain,both the Daphnia and the Alona are important links.They are more sensitive to toxic substances than most fish.A threat to them,provides an early warning of ecological threat to the entire food web.

This bioassay experiment was designed to test Daphnia and Alona at varying levels of pH and study their mortality rate and determine their LC50(50% Lethal Concentration).

LC50 is defined as the concentration of a toxicant at which 50% of the organisms die.Death for the Daphnia was defined as"the absence of pumping movement in the organism when examined under a microscope." In the case of the Alona,death was defined as"the failure to move even when prodded and examined under a microscope."

The data collected pointed to the conclusion that fresh water microorganisms,like Daphnia and Alona,are adversely affected by low pH levels.Therefore acid rain does present a very real threat to these organisms and consequently to the entire aquatic life system.

The 105min LC50 for Daphnia:pH 5.2
The 105min LC50 for Alona :pH 4.2

#THE EDWARDS AQUIFER: IS THERE A POTENTIAL POLLUTION HAZARD FOR THIS IMPORTANT WATER SOURCE?

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Water is vital constituent of everyday life. Its uses are for drinking, irrigation, and industrial processes. The sole source of water for over one million people of South Texas is the Edwards Underground Aquifer. This aquifer is a cavernous formation encased in limestone that is filled with water. Is the Edwards Aquifer contaminated presently and is it possible to pollute it?

To find if the aquifer is polluted, twelve well samples from diverse areas in the aquifer zone were collected and analyzed extensively for different organic and inorganic pollution parameters. With the exception of finding a slight amount of oil and grease in one well, no primary pollutants of considerable amounts were found. However, secondary pollutants were found in numerous wells. These secondary pollutants only cause inconveniences such as taste problems, scale formation, and staining.

Many conclusions were drawn from the data. The oil and grease could have been due to a number of factors all of which are outlined. The secondary pollutants are present because they dissolved from the inner walls of the aquifer caverns. However, many factors influenced this rate of solubility and are outlined. Finally, it is believed that it is not possible to pollute the aquifer in the aquifer zone. But pollution through improperly sealed wells and the recharge zone is very possible. One long run implication of this project is the experience in analyses gained.

#Second Award - American Association of Petroleum Geologists
Third Award - American Society of Civil Engineers

ANALYSIS of NITROGEN DIOXIDE CONCENTRATIONS and THEIR VARIATION with ELEVATION

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Nitrogen dioxide is a harmful toxin which is released through automobile emissions and as an industrial by-product. High concentrations of nitrogen dioxide are significantly related to acid rain as well as being a constituent of atmospheric pollution.

While conducting experimentation to measure nitrogen dioxide levels, I observed an interesting variation in nitrogen dioxide concentrations as compared with elevational changes. This phenomenon was so interesting I focused my research on the measurement of the levels of nitrogen dioxide as effected by elevation.

I adapted the British modification of the Griess-Ilosvay reaction to measure the nitrogen dioxide levels. To increase accuracy of this analytical evaluation I used a photoelectric colorimeter to determine the endpoint of the reaction. For five months I measured the concentrations along the Wasatch Front.

I measured nitrogen dioxide levels one mile south of an emissions source at an elevation of 4230 feet. I then measured nitrogen dioxide levels at an equal distance, but I went to an elevation of 4650 feet. With comparison of my data, I observed a marked variance in the nitrogen dioxide concentrations. My data shows higher concentrations of nitrogen dioxide at the lower elevations with the lower concentrations of nitrogen dioxide at the higher elevations. This difference could be due to the greater molecular mass of nitrogen dioxide when compared to that of air.

#THE INFLUENCE OF LIGHT AND OLFACTORY CUES ON THE HOST-FINDING ABILITY OF THE PARASITIC WASP OOENCYRTUS KUVANAE: A KEY COMPONENT IN TOMORROW'S SOLUTION TO AN INTEGRATED GYPSY MOTH CONTROL PROGRAM?

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The gypsy moth is a serious defoliator of trees throughout the world, causing millions of dollars of damage annually. Current gypsy moth research is aimed at preventing gypsy moth outbreaks by maintaining gypsy moth populations at manageable levels without doing harm to other life forms. Thus, biological agents such as gypsy moth egg parasite wasp, Ooencyrtus kuvanae, may play a major role in future integrated gypsy moth management. Although these wasps exhibit a strong attraction to high density gypsy moth populations, the cue that the wasp uses to locate a gypsy moth egg mass are not known. The influence of light and olfactory stimulation (produced by egg mass odor) were investigated. Choice-boxes were designed which allowed the wasps to display their host-finding preferences. The results indicate that the host-finding ability of the wasp is greatly influenced by both light and olfactory cues. The wasps were ten times more likely to go to an egg mass in the light than to an egg mass in the dark, and four times more likely to go to a dark area with egg mass odor than to a dark area without odor. Overall the wasps are inhibited to enter the dark. However, in low gypsy moth populations most egg masses are laid in dark areas and to maintain a resident wasp stock parasitization in the dark is important. In order to integrate the parasite wasp in an effective pest control program, I am attempting to breed a strain of wasps that will enter a dark area to locate and parasitize gypsy moth eggs. This strain, coupled with hanging wicks of manmade egg mass odor, may lead to a solution to the century-old gypsy moth threat.

#Second Award - Entomological Society of America
Fourth Award - General Motors ISEF

SNOW ANALYSIS OF SPECIFIC AREAS IN BENTON & HUMPHREYS COUNTIES

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Ten snow samples were gathered from Benton and Humphreys counties, along with other experimental materials, for research. Tests for alkalinity, ammonia, carbon dioxide, chlorides, chlorines, chromium, salinity, sulfides, and pH were conducted on these samples as described in the LaMotte Water Quality Analysis Manual. It was found from this experiment that various amounts of substances were detected in these samples. Results from this experiment indicated that the snow contained substances that might be damaging to human health.

CALORIE CONTENT OF WOODS

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113 E. Greenbriar, Vinita, OK 74301

The purpose of this project was to determine if the heat value varies in different types of wood. Then if there is a difference, which type of wood has the highest value?

Equal amounts of six different types of wood were burnt under a breaker containing 500 grams of water. The temperatures before and after burning were recorded. Each type was tested twice.

The quanity of heat was measured in calories. A calorie is the amount of heat energy required to raise one gram of water one degree centigrade. The difference in the temperature of the water before and after heating times 500 was the amount of calories produced.

Oak has the highest heat value followed in order by hickory, walnut, mahogany, pine, and cedar. Oak is the densest with hickory, walnut, mahogany, pine, and cedar less dense in that order. In finding heat value of a type of wood a relative density of wood chart could be used instead of this experiment.

SILVER MINES IN A PESKY PLANT: AN ANALYSIS OF THE PRESENCE OF SILVER IN THE ROOT SYSTEM OF THE WATER HYACINTH PLANT

Stewart, David R., Metairie Park Country Day School, Metairie, Louisiana 70005; 1225 Focis Street, Metairie, Louisiana 70005.

The problem dealt with in this investigation was to determine the presence of silver in the root system of the pesky plant, the water hyacinth. The roots of selected water hyacinth plants were extracted and boiled. The solutions obtained were submitted to various tests for silver and the results were compared with control samples subjected to the same tests. (The control samples were spiked with silver.) Two of these tests used copper to obtain a silver precipitate. One test used nitric acid and sodium chloride to obtain a silver precipitate. Four tests used the chemicals: HCl, K_2CrO_4, KI and H_2S. All of these experiments demonstrated the presence of silver in the root system of the water hyacinth. It was concluded that some silver was present in the root systems of the water hyacinths selected for the above investigations and analysis.

LIMNOLOGY OF THE TROPICAL LAKE, SANTUARIO DE AVES: FIRST REPORT

Ortiz-Zayas, Jorge R., Barranquitas H. S., Barranquitas, P. R. 00618, Bda. La Vega #40-A, Barranquitas. P.R. 00618

Limnological measurements were conducted in a shallow tropical lake as a first step of an investigation designed to study the effects of cattle egrets (Egretta Alba) on lake ecosystem function. At a water-surface elevation of 700 meters above mean sea level, Lago Santuario de Aves (Bird Sanctuary) has an estimated surface area of 2 600 m², a maximum depth of 4 meters and a volume of 550 m³. A small creek contributed 0.88, 51.3, 2 171, 7.66 Kg/day of phosphate, potassium, nitrates, total hardness (Ca+ - Mg+ and dissolved oxigen respectively. These materials had a turnover rate of 124, 47, 77, 84, 135 annually. Secchi depth was 67 cm. Rates of photosyntesis exceeded respiration by P/R = 1.7. No thermal stratification was observed.

Results show high nutrient levels and high primary productivity rates probably due to nutrient impacts by egrets and adjacent agricultural activities. Typha dominguesis Pers is the dominant aquatic plant in the lake. About 5 000 Egretta Alba inhabit part of the surrounding area.

CONVERSION OF THE GASEOUS POLLUTANTS OF COAL BURNING PLANTS INTO COMMERCIAL FERTILIZERS USING A MODEL EMISSION CONTROL SYSTEM

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OBJECTIVE: The objective is to design and test a system which would convert gaseous pollutants into high yields of ammonium sulphate and nitrate. A cost analysis and a nitrogen and sulphur analysis are also performed.
METHODS: Several types and grades of coal are obtained. The coal samples are analyzed using the Kjeldahl method for nitrogen and a high-temperature combustion method for sulphur. A quartz tube connected to an oxygen tank on one end and leading into a flask of 20% NH_4OH is obtained. A crushed sample of coal is placed in a combustion boat inside the quartz tube. A catalyst of Fe_2O_3 is also placed in the tube. The catalyst is heated to red hot and the coal is ignited. The resulting solution is dried, weighed, and redissolved with water and HCl. This is boiled for 10 minutes to destroy any carbonates. The solution is dried, reweighed and redissolved in water. A solution of 30% $BaCl_2$ is added. The precipitate is weighed. The weight of the precipitate is proportional to the weight of sulphate formed. The sulphate yield and the nitrate yield are calculated. This procedure is repeated for all samples.
RESULTS: The sulphate yield was high. The high, low, and average were 98.97%, 81.89%, and 90.17%. The nitrate yield was lower. The high and low were 86.03% and 20.54%. The average was 46.49%. The average production cost was $86 for the nitrate and $44 for the sulphate.
CONCLUSIONS: The sulphate yield was high compared to commercial production. The nitrate yield was about average with commercial production. A system such as this could produce relatively cheap fertilizer while removing toxic gases.

#First Award - United States Navy/Office of Naval Research
Alternate to Scholarship - United States Marine Corps
Honorable Mention - American Intellectual Property Law Association

THE SYNERGISTIC EFFECT OF MAGNETISM AND LIGHT ON SYMBIOTIC HYDRA AND PARAMECIUM

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Symbiotic organisms form unusual reciprocal and beneficial relationships. The problem was to study the effect of magnetism and light on 2 such microorganisms--Chlorohydra viridis and Paramecium bursaria. The hypothesis was that magnetism and light colors would cause a positive tropism in the symbiotic microorganisms and not in the non-symbiotic ones. Procedure for hydra was to count number of symbiotic and non-symbiotic hydra turning to a magnet on a microscope stage under colors of light. The procedure for Paramecium was to count number of symbiotic and non-symbiotic paramecium found at a magnet and non-magnet end of a glass tube in various light colors. In results, only the symbiotic hydra turned to the magnet in light colors of red, blue, green and yellow. Only the symbiotic paramecium showed a higher number at the magnet end of the glass tube in the light colors of red, blue, and green. The conclusion is that symbiotic organisms of hydra and paramecium show a more sensitive response to magnetism and light. Perhaps this is an adaptation that helps both survive better in their environment.

#DISCOVERY OF ENVIRONMENTALLY SAFE METHODS OF ERADICATING SOLENOPSIS INVICTA AND FUNGI

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This project is the result of diversified experimentation performed for the general purpose of establishing a safe method of eradicating Solenopsis invicta and Trichophyton mentagrophtes. The project is a three-year study which divides the work into five distinct phases. In PHASE I of the project, a mound-to-mound application to eradicate Solenopsis invicta by using gelatin capsules filled with a bait and the systemic poison chlordane was established. The baits used were in sorted combinations of grits, corn, chocolate, and butter extract. PHASE II deals with the follow-up study of all experimental areas to observe the possible changes in the chlordane level. PHASE III is the establishment of oil from Citrus sinensis as an aerial applicant to eradicate Solenopsis invicta. PHASE IV tests for other applications of Citrus sinensis. Included are shelf-life extension and the eradication of Trichophyton mentagrophytes. PHASE V is a comparison of the components of orange and lemon oils.

The benefits of this project are many. First, numerous restricted poisons will be available for public use. Second, Citrus sinensis will be the aerial applicant available for statewide use. Third, the manufacture of Citrus sinensis will involve the "recycling" of various citrus epidermis therefore creating less waste. Fourth, the natural fungicide will produce a longer shelf-life for citrus fruit, and fifth, Citrus sinensis can be used as a fungicide for other human benefits. Continued studies will follow in hopes of defining the patent rights due these ideas.

#Fourth Award - General Motors ISEF

INDUCING RESISTANCE TO FREEZING STRESS THROUGH INCREASED ABSORPTION OF CALCIUM

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The intent of this research was to devise a means other than micorbial antifreezing to combat the effects of frost on soybean (Glycine max).
It was hypothesized that, since several calcium oxalate containing plants of the Arum family have been shown in nature to generate additional heat, domestically grown plants may become more resistant to frost if they can be induced to take up more calcium. In addition, it has been shown that a 6.25% solution of DMSO (Dimethyl Sulfoxide) added to a hydroponic solution induces additional nurtrient uptake in plants. It was also hypothesized that an addition of DMSO to a calcium chloride solution might increase the amount of calcium uptake from a hydroponic medium. In addition, the ability of DMSO to penetrate directly through living membranes may permit it to be used in a spray to carry additional calcium to plants in a soil medium.
Plants were grown from seeds under identical conditions. Experimental groups consisting of a control, a DMSO hydroponic group, and a DMSO topically applied soil group were compared for resistance to decreased temperatures in controlled environments.
The controls of each experimental group produced definite signs of freeze damage. Plants which had an addition of .1g/l calcium chloride, no matter how it was administered, did in fact show no visible signs of freezing stress when exposed to temperatures of -10°C and up for a period of 6 hours.

#Second Award - General Motors ISEF

THE ENVIRONMENTAL EFFECTS OF ACID RAIN - A FOUR YEAR STUDY

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Rockledge High School
220 Raider Road, Rockledge, FL 32955

The term "acid rain" is a fairly recent addition to our language; however, this phenomenon of acid precipitation and deposition, composed of sulfur dioxide and nitrogen oxides, may date back to the 18th century. It has become a recognized problem for scientists since the 1950's and has become the "environmental time bomb" of the 1980's as it continues to defile major areas of our planet, including Florida.

To further expand his four-year study of acid rain and to seek possible solutions to the problem, this researcher developed a sampling system to determine atmospheric deposition of acidity and air quality levels. Additionally, 3 outdoor aquatic model ecosystems and 6 indoor environmentally controlled aquatic ecosystems for use in assessing biological effects of pollutants were constructed. To further substantiate data, controlled laboratory experiments were conducted using Japanese Medaka fish embryos and rainwater.

Comparative analyses from these experiments indicated rainfall in this area in the acidic range; air quality levels were normal for the area tested. Data gathered from the ecosystem experiments revealed that buffers containing calcium carbonates can help reduce the acidic levels of water. A comparison of the results of the embryo and ecosystem experiments indicated a definite correlation between low pH readings and unborn fish. Based on the data compiled during this test period, and from previous studies by this researcher, it is further concluded that acid rain is an environmental hazard to Florida. Continued research is urged to further evaluate the environmental impact to our state and to seek solutions to this growing and far-reaching problem.

#Second Award - Bureau of Reclamation/U.S. Department of the Interior
Second Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

#THE BOG PHENOMENON

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After reading an article in the West Virginia Magazine, Wild, Wonderful West Virginia by Dr. Gerald Lang, Assoc. Prof. of Biology at WVU, entitled "Wetlands for Acid Water", in which Dr. Lang discovered through research in the Tub Run Bog located in Tucker County, WV, acid mine drainage water running into the wetland bog was being neutralized to some degree by the organic plant composition of the bog, I decided to attempt to verify if wetland bogs will neutralize acid mine drainage.

I made a trip to a wetland bog in Tucker County, WV, and brought home a 3'X4' section of the bog containing sphagum and polytrichum moss, ferns and peat to create a simulated bog that I could experiment on a smaller scale over a period of time. Once I had my simulated bog growing, I changed the pH within the bog (pH 5.0) to a pH of 3.3 by percolating acid mine drainage that I collected in Tucker County through the bog. The pH was then checked and recorded for a period of ten days. The bog changed from a pH of 3.3 to a pH of 4.8 over the ten-day period. During the period of the reaction, a faint odor of hydrogen sulfide gas was noticed, thus indicating that the sulfate-reducing bacteria was occurring.

Therefore, my conclusion is that plants and organic peat that compose the wetland bog do have the potential to neutralize the acid mine drainage over a period of time. Also, it might be possible to reduce acid pollution through nature's "bog phenomenon" by transplanting the components of a wetland bog adjacent to mine drainage runoff. This would be an economical way to use nature to cure a manmade environmental problem.

#Fourth Award - General Motors ISEF

MATHEMATICS

SUBREGIONS OF TOTALLY DISSECTED REGULAR POLYGONS

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This project began as an investigation of the number of non-overlapping subregions in a totally dissected regular polygon, one with all diagonals drawn. A formula relating the number of non-overlapping subregions to the number of vertices for a dissected polygon with an odd number of sides was obtained by developing a method of repeatedly taking the differences of a sequence. This difference method was also used to show that the number of subregions in the even case probably can not be expressed as any combination of polynomial or exponential functions. The difference method was then extended to obtain expansions of algebraic expressions using summation notation.

Finally, this difference method provides a quick and elegant method for finding the polynomial which passes through certain points on a graph. Ordinarily, if one is given k arbitrarily chosen points, a system of k equations in k variables must be solved to find the coefficients of the polynomial of degree k-1. However, if the abscissas of these points from an arithmetic progression, the difference method can be used to find the coefficients with much less time and effort.

#Third Award - General Motors ISEF

A FOUR-YEAR COMPUTER-AIDED STUDY OF THE DISTRIBUTION OF PRIME NUMBERS

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Mathematicans have long been fascinated with the prime numbers. As man's understanding of the distribution of prime numbers increases, so does our understanding of all mathematics. Still, the distribution of the primes remains a paradox.

The intent of this project is to bridge the ideas of many and fuse them with the original ideas of the researcher. There are many general rules that apply to all prime numbers; a great deal more are less definite.

Using at least five compuer systems throughout Florida, the researcher has analyzed the distribution of prime numbers. By placing the natural numbers in several forms of spirals, and highlighting the primes, various patterns in the distribution of primes can be visually demonstrated. Equations producing a high density of prime numbers can be predicted from careful examination of the spiral graphs.

Using a modified form of the Sieve of Eratosthenes to find the primes, several computer programs were created in various languages, including Pascal, to place the naturals in spirals and count the of primes on various diagonal lines, Although it is difficult to obtain new conclusions to a problem that has puzzled mathematicans since antiquity, definite patterns can be demonstrated using spiral graphs.

ESTABLISHING MEDICAL LABORATORY REFERENCE VALUES FOR CROOK COUNTY

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Normal values are established using test results of healthy people. Reference values are figured using the results of people in a "defined state of health." Reference values for lab tests vary from area to area. Several factors of variation in Crook County are : environment, altitude, high percentage of elderly, and high number of men in labor-intensive occupations. Presently "normal" values are being used.

PURPOSE: This project established reference values for Crook County.

PROCEDURE: Files were made of the results of fourteen months of the following tests:

white blood cell count	glucose	potassium	calcium	amylase
carbon dioxide content	BUN	uric acid	chloride	
hematocrit	sodium	creatinine	hemoglobin	

These tests were chosen as there is little reason for them to be affected by the type of patient the test is usually run on. A program was written to formulate the references using statistical analysis. The mean, variance, standard deviation, coefficient of variation, and reference limits were calculated. Values outside the set limits (two standard deviations) were deleted. The values were then refigured. This loop continued until no data was outside the set limits. The resulting limits are the reference values.

RESULTS: For several tests, significant differences were found between the new "reference" values calculated for Crook County and the "normal" values now being used. However, tests with very small numbers of test results did not appear to yield viable reference values as proven by large coefficients of variation. These reference values show that there is a viable reason to establish reference values.

#DETERMINING ALTITUDE THROUGH AERIAL PHOTOGRAPHY

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Sparta, Tn. 38583

The purpose in this project is to develop a procedure for determining altitude of remote control airplanes. F.C.C. regulation prohibits flight of aircraft over four hundred feet. Hobbiests, however, cannot use altimeters and have no proven method of adhering to these regulations.

The procedures involved the innovation of a camera mount to the plane's fuselage in such a way to take aerial photos using remote control. The next step utilized mathematical processes through which the altitude could be ascertained. The third step involved verifying test results.

Tests made with photos taken under controlled circumstances proved the rate of object size reduction remained the same regardless of height. Calculations using this data became the basis of computations dealing with photos taken from unknown altitudes. Two mathematical processes were used to determine altitude at the time aerial photos were taken. Pictures taken from a Cessna aircraft at an altitude of 1800 feet and a topography map were used to verify test results.

Test results substantiate the view that aerial photography is one method by which the altitude may be determined. While calculations could not be made to establish one hundred percent accuracy, calculations were within the altimeter's reading, and this project opened opportunities for research in important military and civilian application. One example of a relevant application of this project is aerial survey and mapping.

#Honorable Mention - Eastman Kodak Company

A STUDY OF THE EFFECTS OF THE VARIATION OF THREE NUMERICAL FACTORS ON THE GRAPHS OF THE SIX TRIGONOMETRIC FUNCTIONS IN POLAR COORDINATES

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The purpose of my project is to determine the effects of the variation of 3 numerical factors on the six trigonometric functions. This is done, however, not in regular cartesian coordinates but in polar coordinates. The system of graphing in polar coordinates involves using an ordered pair, (r,θ), where r is the distance of the point from a point in the middle of the system called the pole and θ is the angle made by the radius and the positive X axis. To begin this study, I plotted the graphs of each of the trig functions with no factors involved. In doing all the graphs, I first calculated r for different values of θ with a calculator then recorded the data in tables. I found out that the graphs of the sine and cosine functions are circles that differ only in their orientation on the paper. The graphs of the secant and cosecant functions are straight lines, one vertical and one horizontal, and the tangent and cotangent graphs are strange figures. These figures look like long, drawn out x's that never touch the angles at which they are undefined. The tangent graph is vertical and the cotangent graph is horizontal. Since the co-functions have similar graphs, I used only one function from each set to further my study. By using the values 1-5 for $\underline{a}$ in $r=a \sin \theta$, $\underline{k}$ in $r=\sin k\theta$, and $\underline{c}$ in $r=\sin(\theta + c)$, I graphed the effects of the variation of these factors. I then formed theorems concerning the graphs of the original and altered equations and proved them by changing the polar equations into cartesian equations. This is done by substituting the square root of $x^2 + y^2$ for r, y/r for sine, x/r for cosine, and y/x for tangent. I found that the six basic equations and the ones involving the factors $\underline{a}$ and $\underline{k}$ could, in fact, be proved.

SABERMETRICS: THE MATHEMATICAL AND STATISTICAL ANALYSIS OF BASEBALL RECORDS

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PROBLEM: I wanted to develop and apply different formulas that would rate baseball teams and baseball players. The team results could be used to predict the future season in a logical manner or evaluate the past season. The player results could be used for determining approximate values or be put together for more precise team results.

HYPOTHESIS: The first thing I did was to come up with formulas and prove that they work by applying them to last year's statistics. If they work for teams, then you can assume that they work for players, too. After proving that my formulas worked, I could apply several of them together to come up with more advanced results.

METHODS: To predict a team's future results, I used applications of several different proven formulas. The basic idea was to find each player's amount of runs scored and each pitcher's runs allowed on a team, which were based on a two year period. These were added up to find the team total. After the projected number of runs scored and allowed are determined, then the winning percentage can be determined by a proven formula. Several unique statistics were derived by the use of my formulas on individual players, such as lead-off efficiency and other runs based information.

CONCLUSION: Sabermetrics could do everything described in the "problem" and more. It has several uses, including a logical method for predicting future team results, a mathematical way to rate players, and a judge to see a player's strengths and weaknesses.

#RATIONAL NUMBERS IN DECIMAL NOTATION

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The purpose of this project is to explore various aspects of notating rational numbers in the decimal system and to design computer programs based on the relevant findings to determine any rational number with complete accuracy. Six theorems make these programs possible:

I: When $1/r$ is written in the decimal system, a pattern of digits must start repeating by the $(r+1)$th digit.

II: If $1/r$ is terminating, then $r = 2^t5^f$, where t and f are integers. If $t>f$, $1/r = (5^{t-f})/10^t$. Otherwise, $1/r = (2^{f-t})/10^f$.

III: a/b is partly repeating if and only if b has factors of 2 or 5 or both. (a/b is in lowest terms.)

IV: Suppose $r = 2^t5^fz$, where t, f, and z are integers and z has no factors of 2 or 5, and let q be max(t,f). Then q is the number of digits before the repeating pattern in m/r begins, provided m≠r and m has no factors of 2 if $t>f$, no factors of 5 if $f>t$, and no factors of 10 if $f=t$.

V: If the repeating part of $1/r$ has q digits in it, then $1/n^m$ has a repeating pattern of length qn^{m-c}, where c is the largest integer such that $10^q \bmod n^c = 1$. (m≠c, and n may have no factors of 2 nor 5.)

VI: If the repeating length of $1/n$ is q and the repeating length of $1/n'$ is q', where n and n' have no common factors and no factors of 2 nor 5, then the repeating length of $1/nn'$ is the lowest common multiple of q and q'.

Also, certain facts found while proving these theorems and a new method of obtaining $1/r$ are explained and proven.

#Fourth Award - General Motors ISEF

QUADRATIC RESIDUES IN GAUSSIAN INTEGERS

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The problem of determining whether a given number is a quadratic residue of m in the field of integers has attracted attention of many mathematicians. In this paper, I am trying to extend the idea of quadratic residue to the field of Gaussian integers. Also, I have investigated methods of determining whether a number is a quadratic residue of another in the field of Gaussian integers. In the future, I hope to investigate higher degree of reciprocity laws and to expand the idea of quadratic residue into other mathematical systems.

#Third Award - General Motors ISEF
Third Award - Mathematical Association of America

IMAGINARY ROOTS OF POLYNOMIAL EQUATIONS

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Solving equations with more than one pair of complex conjugates requires complex mathematics and some trial and error. Often too much time is spent trying to solve these equations for the roots. This project accomplishes this by using non-calculus methods. The process involves synthetic division where the divisor is a complex number and the remainder (when not a root) is graphed. From the curvature and eccentricity of each curve, the roots can be determined.

STUDY TO DETERMINE THE MAXIMUM NUMBER OF ANGLES, TRIANGLES AND CLOSED SIMPLE REGIONS THAT WILL BE FORMED BY THE INTERSECTIONS OF n (n-1)/2 LINES WHICH ARE DETERMINED BY n POINTS IN A PLANE WHERE ANY THREE POINTS CAN NOT BE LYING ON THE SAME LINE

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This research shows the solution of a geometry problem which consists of establishing a series of formulas that allow us to find the maximum number of angles to be formed by the intersections of lines determined by n points on a plane were any three points can not be on the same line and the maximum number of triangles and simple closed regions to be formed by these lines which are determined by pairs of points.

To solve the problem, the most simple situations were observed: n=2, n=3, n=4, and n=5. Using this method, it was found that the maximum number of lines were determined by the formula $n(n-1)/2$, the maximum number of angles determined by the formula $(n^4 - 2n^3 - n^2 + 2n)/2$ the maximum number of regions determined by the formula $(n^4 - 6n^3 + 15n^2 - 18n + 8)/8$, and the maximum number of triangles by the formula $(n^6 - 3n^5 - 11n^4 + 59n^3 - 86n^2 + 40n)/48$. In this research, algebra was used; furthermore, all results were demonstrated by the method of Mathematical Induction.

#TRINOMIAL EXPANSION

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The purpose of this project was to find a method of generating the sequence of (a+b+c)^n raised to the nth power. A second objective was to find the most general formula for calculating the coefficient of any term.

To do this, the expression (a+b+c)^n was raised to the powers of two through seven manually. Because of the great number of terms involved, this became very time consuming. A program was developed in Basic to do some of the work. An apple computer did not have enough memory, so the counter program was rewritten in Kaffer.

The results were presented in tables and mappings so analysis of the coefficients could be made. Key to this project was the idea of symmetry and consistency. To show symmetry in a trinomial expansion, there is needed three axes, one for each variable. Using this, a mapping scheme was developed with circles that had axes 120 degrees apart.

Some of the conclusions were that the sum of the terms was equal to three raised to that power and that at every third power a new pyramid starts. Also, Pascal's Triangle illustrates the number of terms in a multinomial expansion; and the number of edges, points, and faces of geometric shapes.

Finally, it was determined that to find any given term's coefficient of (a+b+c)^n raised to the nth, can be found by the formula; n!/(p! * q! * r!) where p, q, and r are the powers of the variables a, b, and c.

#Fourth Award - General Motors 1987

#SOAP FILM CALCULUS

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The problem of surface area minimalization is a century old problem in calculus of variations, which was solved about ten years ago and shown to be demonstrated in soap films. One rule to which soap films always adhere is that when three films meet at one edge, they do so at 120 degree angles. This project shows that lines meeting at 120 degree angles compose the solution to the two dimensional analog of the problem, finding a minimum distance path that connects three points in a plane.

The proof of the minimal area problem requires calculus of variations, but the minimum distances problem can be solved by using only multivariable calculus, which has not been done before in this exact way. The path itself consists of three lines joining the points to an arbitrary point, defined in polar coordinates. The net distance of the path can then be expressed in terms of the coordinates of the point and three given constants. Differentiating the function and setting the first partial derivatives equal to zero results in the solution that the angles which the three lines make with each other are all 120 degrees. To rule out the possibility of a saddle point or a maximum, a second derivative test is applied. The entire proof is on display with the project. The minimum distance path connecting the three points does, in fact, consist of three lines joining the points to an internal point such that the lines meet at 120 degree angles.

#First Award - United States Navy/Office of Naval Research
Second Award - General Motors 1987
Second Award - United States Army

FINDING INTEGRAL ZEROS OF POLYNOMIALS IN Z[X]: AN ORIGINAL ALGORITHM

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It is soon discovered when attempting to find zeros of polynomials that the algorithms most generally used (e.g. the rational root theorem, etc.) are at times inadequate. Although these methods reduce the number of possibilities (which may be great in number), they (the possibilities) must be "plugged into" the polynomial to see whether or not they are indeed zeros.

In this paper, an alternative method is presented that uses a theorem concerning norms in quadratic fields (the theorem is also presented). The only drawback to this new method is that it only finds integral zeros of polynomials only in Z[x]. Due to this fact testing is confined to monic polynomials (because the only rational zeros of monic polynomials are integral). The new method is compared to the rational root theorem for speed. The results are finally evaluated for significance.

After testing it is concluded that the new algorithm is not as fast as the rational root theorem for the test data. A slight modification is noted that may increase its efficiency. Additionally it is suggested that the algorithm might be combined with other existing algorithms to create a super-efficient hybrid.

PRACTICAL ALTERNATIVE TO SQUARE A NUMBER

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Since no practical way has been available to square a number other than multiplying the number by itself, which becomes somewhat impractical on numbers greater than 1000, the following equation is presented as a simplified method. The equation has been named the PA Equation (Practical Alternative).

MATH AND MUSIC

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As seen in my title, my primary objective was to prove that math and music can combine to form a sensible musical number system for the blind, but this study has proven much more than that. In my attempt to develop a workable musical number system, I established four test systems. Each system had a different combination of tones and sound waveforms (refer to research charts #1 and #2 for more detailed information). I then tested nineteen blind students with computer programs that played the notes in each system in order of pitch from lowest to highest for approximately nine minutes, after which the same notes were played but in a nonspecific order. At that point, I asked the student involved to identify the note. I calculated the percentage of correct answers in each system, compared the data, and found that I had proven three additional items. They are as follows:

1. Taking music lessons greatly increases a persons ability to recognize tones.
2. Notes played in the pulse waveform are more easily identified than those played in the triangle waveform.
3. Notes that are one space apart on a musical staff are harder to distinguish than notes that have three spaces between them.

MAGICAL NUMBERS AND SERIES

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In this paper I will be proving the fact that if any four-digit number is selected in any base number system and we rearrange its digits first in decreasing order ($N_>$) then in increasing order ($N_<$) and subtract the two numbers [$T(N)=N_>-N_<$] we will always result in a constant number or a series. Working with all the four-digit numbers in base ten, I found that the number 6174 always appears in less than eight applications of this function.

Instead of testing every four-digit number, certain manipulations allowed me to test only thirty numbers. These thirty numbers represented the numbers that resulted after $T^1(N)$. i.e. $T^1(N)$ mapped all numbers to only thirty different numbers. Pursuing each of these thirty numbers on the computer, I was then able to say that all the numbers had been tested.

Using the same concepts, I then extended the function to include other bases. Looking at the generated Magical Numbers/Series I then began to notice several patterns between the bases. However, more time is still needed to prove why these patterns occur and if these patterns are a valid method to find these Magical Numbers and Series.

Keeping in mind that every number has an unique prime factorization, these Magical Numbers and Series can then be applied in the field of cryptology.

#ALICATION OF THE BOOTSTRAP METHOD TO THE ESTIMATION OF POPULATION PARAMETERS DERIVED OF VARYING DENSITY DISTRIBUTIONS

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The Bootstrap Method is a vanguard, computer-intensive statistical procedure which estimates population parameters from sample data without assuming any parent population density distribution. I have applied the Bootstrap method to the prediction of a population parameter with the hope of validating its effectiveness and demonstrating its superiority over the traditional , Normal Theory, statistics. The procedure involved Normal Theory and Bootstrap analysis of the variability of the variance of populations of Gaussian and non-Gaussian distributions. My findings indicate that the Bootstrap method correctly predicts the margin of error of a sample variance estimate, while the Normal Theory method fails to do so when it is applied to significantly non-Gaussian distributions. These findings led me to believe that the Bootstrap method is superior to the Normal Theory method in all distribution-sensitive estimations. However, when I applied a non-normality measure, sample kurtosis, to the appropriate Normal Theory equation I accurately estimated the aforementioned parameter with only a few calculations. I beleive that the success of this innovative application of sample kurtosis to the Normal Theory may be extended to all cases wher an analytical relationship of the sample parameter to the corresponding population parameter exists. Therefore, the Bootstrap method remains attractive only in cases wher such a relationship does not exist or cannot be readily developed.

#Fourth Award - General Motors ISEF

STUDY OF THE FOURTH DIMENSION

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The fourth dimension has been known since long. One has known how to study and manipulate a four-dimensional body. The only problem has been that it is very hard to understand what a four-dimensional body looks like by just looking at a picture. One can also build a three-dimensional projection of the four-dimensional body, but this takes a lot of time. The best thing would be, if one somehow could get an immediate three-dimensional picture, and easily rotate and manipulate this picture.

My idea was to have a computer making the pictures. If the computer could draw the picture in perspective, this would be almost the same as looking at a three-dimensional projection. Starting with formulas for rotations in four dimensions, I constructed a program that would be able to do this. In my program, the four-dimensional body is directly projected into two dimensions. To be able to do this, I had to construct a formula of my own that would allow me to do that, and give me perspective in the picture.

The result of my work is now a program that fullfills these demands. By using this program, one can study the fourth dimension in a very easy way, and notice many interesting things.

AN EXAMINATION OF THE RELATIONSHIPS BETWEEN SUCCESSIVE ELEMENTS OF NON-REPETITIVE VERSUM SEQUENCES IN ALL BASES

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Formulas were developed to procure conditions upon the ancestors of a given number created by the ARD process. These formulas constituted a calculus of palindromes; the complete set of ancestors of a given palindrome created by the ARD process could be determined. The purpose of this study was to eventually disprove certain bases regarding the ARD conjecture, that all numbers in a given base will become palindromes if repeatedly subjected to the ARD process. Thus, the formulas were implemented into computer programs in an effort to disprove different bases. Results were taken that indicated a disproof of the bases, but no definite proof was established.

INVERTED CONES ILLUSTRATING THE CENTER OF GRAVITY

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The mathematical paradox of inverted double cones rolling uphill is, as I found out, a highly uncommon subject. While actually descending, a roller, made by inverting two congruent circular cones at their vertexes, appears to roll uphill.

With a constructed model of the paradox, I will point out and present the ability of the paradox to also illustrate the change in the center of gravity of the inverted cones, explaining how and why such an illusion is produced.

To go about such an experiment, different cones of varying measurements will be used on a given model determined by a mathematical equation that had to be fufilled in order for the paradox to work.

NIM PHASE II: THE THIRD DIMENSION

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This study is an analysis of a modification of the game of Nim, the classic game of Nim can be found in many mathematical text books under the heading of game theory, while this version is my own invention. The word, Nim, is an anglicized formof the German word meaning "Take", it's normal configuration has one row of three circles, one row of two circles and one row with only one circle, The game is played by two people alternating turns of removing circle, the loser of the game is the person who removes the last circle.

The purpose of this study is to derive a variation of the classic game, changing the one dimensional game into a three dimensional game. By using Nim game theory theorems and corollaries, translations of the one dimensional games rules, design and mathematical aspects were made for the three dimensional game. Because this is a modulation above the classic game, the new game replaces the circles that were restricted to the first dimension, with three sets of spheres floating on three parallel planes of the third dimension.

After many observations of this version of Nim, I noticed that the player that is first to choose will always lose no matter what he chooses to remove. Since this was more than just a coincidence, I began work on an equation that would lead a player to a definite win. Through this equation I was able to write a computer program that not only runs the program, but will also play against an opponent. It is always able to beat it's opponent through the utilization of the equation which I developed, just as any player who is second can always win the game.

COMPLEX POLYNOMIAL ALGORITHMS

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This project's purpose is to intuitively develop computer algorithms to handle complex polynomials. Computerized Polynomial Algorithms, an earlier project, dealt only with real polynomials, but provided five problems which extend to this project: polynomial expression, evaluation, graphs, derivatives, and roots.

Sequences form convenient polynomial expressions which evaluate easily through a synthetic substitution algorithm. This provides speed and accuracy, which are important to other problems, especially graphing. Each graph requires evaluating several hundred among its four dimensions. Separate, three-dimensional graphs of real, imaginary, and absolute value ranges help visualize the four dimensions.

Real polynomial derivative development leads to a limit process for partial derivatives of a complex polynomial. Despite simplifying the limit process, evaluation is slow. Synthetic substitution allows quick and accurate approximations of derivative points.

Point-slope approximations led to a method of root iteration in which two planes approximate the range components of a complex function. Linear equations describe zeros of the planes allowing determinants to solve the linear equations and provide an improved root approximation.

This project successfully adapted earlier algorithms to complex numbers and developed a quick iterative method to find complex roots. The resultant algorithms allow a personal computer to solve problems often reserved for larger computers. Both the program and the methods have applications in both education and industry.

#First Award - General Motors ISEF

First Award - Mathematical Association of America

First Award - National Aeronautics and Space Administration

LOH'S FORMULA FOR THE INFINITE CALENDAR

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My project, Infinite Calendar, is used to find the day of the week for any date of any years, including before the birth of Christ. The chief difference between my formula and that of others who claim to have perpetual system, is that mine can tell dates before 1600's and also B.C.'s, as well as millions of years into the future. This is why I named it "Infinite," which implies both future and past, unlike the word "perpetual," which only signifies the future. I was able to do this by using mathematics. For example, I found that the Gregorian calendar, which was used after 1582, has a pattern that repeats every 28 centuries. This was my most significant discovery of my work.

After the development of my formula, I devised a working model for practical uses. It contains the formulas, magnetic blocks of dates, calculator and pad to facilitate the user. It is used by first calculating the starting day of each month and then moving the blocks of dates accordingly. Furthermore, this mechanism has references that show all the holidays, including a special algorithm for Easters, which occur at different times each year, as well as tables with numbers to eliminate the use of the main formula for years 1900 to 2025.

#VARIOUS SUMMATIONS WITH THE FAREY SERIES AND THE FAREY SERIES OF FIBONACCI DENOMINATORS

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The problem I worked on was to find formulas for different types of summations (defined in my paper) involving the Farey series of fractions of order n, or G_n, (a series of fractions in lowest terms between zero and one inclusive with denominators less than or equal to n, written in ascending order), and then to prove the formulas I obtained. I arrived at my conjectures for the formulas for the different summations by analysing a progression of numerical examples (G_1, G_2, G_3, G_4, and so on) until I recognized a pattern. I found formulas, in terms of n, for the sum of every element in G_n, for the sum of every other element in G_n, for the sum of every third element in G_n, and then from that point I was able to generalize my conjectures to a formula for the sum of every jth element. I was also able to express these formulas in terms of the number of elements in G_n. Another summation I investigated was the sum of all the numerators of every jth fraction divided by the sum of all the denominators of every jth fraction in G_n, and I found that this sum was always a constant, 1/2, for all n. In proving these results, I used the Well-Ordering Principle, Diophantine equations, and some basic properties of the Farey fractions.

I have also extended these results obtained from the Farey fractions to a variation of the Farey fractions in which all the denominators are Fibonacci numbers (Sy_n). I came upon the idea of incorporating the Fibonacci numbers into the Farey series from an article I came across which presented a variation of the Farey series in which the numerators and denominators were strictly Fibonacci numbers, however the summations on this series did not follow the patterns exhibited by G_n, whereas they did for Sy_n. The proofs involved some properties of the Fibonacci numbers.

#Summer Scholarship - Ohio State University
Third Award - General Motors ISEF

THE PROPERTIES OF THE FACTORIAL TRIANGLE

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The Factorial Triangle is a triangle of numbers similar to the Pascal's Triangle. The elements of the n-th row of the Factorial Triangle are the coefficients of the expansion of the product of the first n terms of the Arithmetic Progression.

The Factorial Triangle is closely related to the Pascal's Triangle in many ways, such as the construction, some of the properties, and even some applications. Besides finding some properties of the Factorial Triangle, I also created a new triangle from the two, which I called the Difference Triangle. Each of its elements of the new triangle is the difference of the corresponding elements of the Factorial Triangle and the Pascal's Triangle. The new triangle also has some similar properties as the Factorial Triangle.

#Second Award - United States Air Force
Fourth Award - General Motors ISEF

GENERATION METHODS FOR NEAR AND TRUE PYTHAGOREAN TRIPLES

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This exploratory research studied different patterns involving true and nearly Pythagorean triples. The researcher created programs for generating triples with given tangents. Series of triples approaching given tangents were also generated and studied. The researcher discovered several patterns including an addition property which assists in deriving subsequent triples in the series whose tangents approach one. A recursive formula to generate series approaching any given tangent was discovered.

#Summer Scholarship - Ohio State University

Title: HERON THEOREM IN E^3

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The well-known theorem of Heron gives a constructive proof of the following assertion by elementary geometric method:

Let A and B be two points and L a line in the same Euclidean plane, then there is a unique point P on L such that QA+QB is minimal at P among all points Q on L.

Similar result in E^3 is obtained here by reducing the problem to that in the euclidean plane. An explicit construction to find P is also established.

Comments on using differential calculus as well as those concerning some related problems are also given.

#ORDERED BEHAVIOR IN CHAOTIC REGIONS

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The objective of this project is to look for evidence of periodic behavior in the region of lambda-values thought to be chaotic for a simple difference equation.

One BASIC and four Pascal computer programs were written to graph the equation in different ways. Period-doubling behavior, where the number of possible solutions doubles as lambda increases, was apparent from a list of the periods of the equation.

Intermittent behavior, or jumping between periodic and chaotic behavior, is visible in a graph of the iterates (x-values) versus time. Although each section of chaotic behavior is different, a graph of the number of times an x-value appears reveals each value appears the same number of times, a sign of periodic behavior.

The attractor map is a graph of possible x-values versus lambda. When a single bifurcation fork was enlarged, it revealed a pattern exactly like the full-size attractor. This type of self-similar pattern is termed a fractal.

This project revealed that the attractor for the equation is fractal in nature, allowing these systems to be studied using fractal geometry. Many values of lambda not contained in an apparent periodic region are periodic. Since the basic fractal pattern contains periodic windows, it is possible that there are an infinite number of these windows at smaller and smaller scales. Lastly, the chaotic regions of intermittent behavior do not appear to be chaotic. This suggests that the intermittent behavior reported by many researchers may actually be alternating simple and complex periodic behavior.

#First Award - Sigma Xi, the Scientific Research Society
First Award - United States Air Force
First Award - United States Army
Scholarship - United States Navy
Second Award - General Motors ISEF
Second Award - Mathematical Association of America
Second Award - National Aeronautics and Space Administration
Alternate - American Committee for the Weizmann Institute of Science

Title: ON THE MATHEMATICS OF "NIM-CHESS" GAMES AND ITS IMPLEMENTATION

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"Nim-chess" game is a popular game among the high school students in the Republic of China. The way to play the games is to place stones on the board which is similar to that of jumping chess. It starts with two players taking turns picking up one or several stones which are placed consecutively on a line. The loser is the one who picks up the last stone.

After a long process of experimentation, deduction, and analysis, I have succeeded in proving two theorems. One of the theorems says: If the first player is determined and both of the players play correctly, then the fate of a particular game is already known before the game start. The other theorem proves a sequence of mechanisms for setting up a sure-win situation.

Based on the two described theorems, a playing algorism which won't miss any earnest chance to settle the game to a sure-win situation is developed. And this algorism is implemented in a computer as the "Nim-chess playing program." If the program has the right to determine who is the first player of a game, it will surely win the games. In other words, this program is certainly of the best "Nim-chess" players in the world. We consider that this study has completely solved the "Nim-chess" problem.

"THE EQUATION OF TIME: AN EXPERIMENTAL AND MATHEMATICAL PROOF

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The purpose of my research project is to prove a set of equations by experimentation and calculation. This set of equations can find the current time if the latitude, longitude, sun's altitude, and azimuth are known. I named this set of equations as "The Equation of Time." The complete "Equation of Time" is as follows:

a = 90 - altitude of sun
b = 90 - (our latitude)
C = Sun's azimuth

c = cos (cos a x cos b + sin a x sin b x sin C)
A = sin (sin C x sin a / sin c)
Time = 12 - STD + (1 if DST) + ((our longitude A)/15)

In order to prove the equations, I first designed andbuilt a special sundial to record the actual time, the sun's altitude, and its azimuth. A smooth and very level piece of wood was used for my sundial with various measurements of circles and degrees drawn on it. A level reader and clock with compass were installed into the sundial for determining surface level and direction. A total of 82 tests were collected between January and February. I also wrote a computer program which calculates and processes my data on my printer where the experimental time is obtained. The results proved that the "Equation of Time" does work. The absolute error between the actual time and experimental time ranged from -22 to +42 minutes. I found that errors are due to the unlevel surfaces, the atmosphere which can bend the sun's rays, the index error, and the earth's changing magnetic field.

MEDICINE AND HEALTH

CHROMOSOMAL CHANGES IN CHRONIC LEUKEMIA

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This project compares the chromosomes of a victim of chronic myeloblastic leukemia with a normal control to determine whether or not there are chromosomal changes in chronic myeloblastic leukemia.

Cancerous mitotic cells in culture were ruptured, the chromosomes stained and photographed, and the karyotype compared to that of the normal control cells.

The chromosomes of the leukemic cells were found to have two structural abnormalities: All of one chromosome 21 was relocated to the top of one chromosome 17 and the distal segment of one chromosome 22 was relocated to one chromosome 9.

These chromosomal changes altered some critical function of the cell, causing a transformation to a malignant cell.

For every rearrangement seen on the chromosomal level in a cell, there is an accompanying rearrangement on the DNA level. Altered DNA structure leads to altered expression of affected genes; causing malignant transformations, or, in some cases, cell death. Specific chromosomal rearrangements can be correlated with specific types of malignancies. Understanding these mechanisms ultimately leads to a better understanding of the cell and the role of genetics in malignancies.

THE ADVERSE REACTIONS OF HYDROXYCHLOROQUINE SULFATE IN LABORATORY MICE

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Hydroxychloroquine sulfate (Plaquenil), an anti-malarial, recently has shown positive effects towards the reversal of rheumatoid arthritis. The main purpose of my experimentation is to study the varying degree of external and mental reaction to four different dosages of Plaquenil and, second, to compare and contrast the levels in which the drug can be taken safely without over adverse reaction to the drug.

My procedure entailed separating five different groups of two mice and studying personal behavior, eating habits, and activities. After approximately six weeks, the mice were given oral dosages at different levels; (5.0 mg/kg body weight, 5.5 mg/kg, 6.0 mg/kg, 6.5 mg/kg). The remaining mice were fed a constant diet, but no medication - control group. The oral dosages were administered in a sterile, separate environment to insure dosage intake. The dosages were given in a processed cheese substance or peanut butter applied to an oat. After the drug was administered, tests were given later to check for amount of activity, behavior, illness, waste and consumation of food. The mice were given the drug for approximately two weeks in which the mice were weighed periodically. In my experimentation, it was found that the higher dosages of 6.0 and 6.5 reacted to the drug greater than did the lower dosages. The reactions included diarrhea, weak muscle tone, loss of weight, and general withdrawn behavior.

My hypothesis is proven that the larger dosage which might be used for chronic rheumatoid arthritis does show more adverse reaction. One might conclude that a patient suffering from rheumatoid arthritis might opt for less effective, but safer, dosages of the drug.

THE INFLUENCE OF AGING ON THE GROWTH OF CANCER

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The aging process has definite effects on the growth of several sarcomas, including the B16 melanoma. As mammals age, there is an increased susceptibility to disease, including many cancers. Older mammals may have a decreased immune response which may partially cause this increased susceptibility to disease. On this basis scientists predict that tumor growth might be enhanced in older mice since the potential anti-tumor responses that might control tumor growth would be weaker.

Groups of C57BL/6J mice of varying ages from 2 to 24 months were injected either subcutaneously or intramuscularly with the B16 melanoma and tumor growth was studied. irradiated C57BL/6J mice reconstituted with either old or young bone marrow were injected with the B16 melanoma and tumor growth was studied.

In some cases the tumors grew more slowly in the young mice, while in other cases the tumors grew more slowly in the old mice. The irradiated mice reconstituted with old bone marrow had significantly slower tumor growth than those reconstituted with young bone marrow.

The rate of tumor growth can be attributed to various factors such as age, antibody production, the presence of macrophages, or skin fibrosis. The data discussed in this report deal with limited aspects of tumor growth in realtion to aging.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

DOES TOBACCO SMOKE HINDER OXIDATIVE PHOSPHORYLATION OF SACCHAROMYCES CEREVISIAE?

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The hypothesis for this experiment is that oxidative phosphorylation, the means by which cells produce ATP(adenosine triphosphate, or energy), is adversely affected when exposed to tobacco smoke. This experiment is designed to show that the rate of oxidation-reduction reactions is slowed in the presence of inhibitors.

The inhibitors were trapped by bubbling cigarette smoke through a water solution. Experimental tubes containing water, yeast(Saccharomyces cerevisiae)/sugar solution, inhibitors, methylene blue, and mineral oil were set up along with controls lacking only the inhibitors. When methylene blue (the final electron acceptor) captured all the electrons from the electron carriers in the yeast cells, the solution turned colorless and ATP was produced.

The results show that tubes containing inhibitors required a significantly longer span of time for methylene blue reduction than the controls. Also, solutions that contained unfiltered smoke of a particular brand of cigarettes took longer to turn colorless than solutions containing smoke from filter tip cigarettes of the same brand. The results clearly demonstrated that the inhibitors in the smoke solution significantly slowed the rate of oxidative phosphorylation, a vital process by which the human body's cells produce and store energy in order for the cells to perform their metabolic functions. Therefore, the overall efficiency of a smoker's body is reduced.

No wonder the Surgeon General has warned that cigarette smoking is hazardous to one's health.

LOCALIZATION OF OPIOID PEPTIDES

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It has been discovered that morphine-like substances, so called opioid peptides, are present in the brain, adrenal glands and some peripheral nerves. The purpose of this study was to examine whether the opioid peptides leu- and met- enkephalin are present in both epinephrine and norepinephrine cells in the adrenal medulla, and whether leu- and met- enkephalin are present in the rat vas deferens; an organ that is often used to measure stength of morphine-like substances.

Immunocytochemical methods were used to localize the enkephalins. After the tissues had been fixed in formaldehyde, they were frozen and sectioned in a cryostat. The sections were then incubated with primary antibodies against leu- or met- enkephalin. Because the primary antibodies could not be seen in the microscope they had to be incubated with a secondary antibody labeled with a fluorescent dye.

In the adrenal medulla, flourescent antbodies against leu- and met- enkephalin were mainly present in theepinephrine-type cells. Most of these reacted with met-enkephalin ad a few with leu-enkephalin. In the vas deferens, many met-enkphalin containing nerve fibers were found close to the lumen. A fw leu-enkephalin fibers were present in the outer sheet.

It can be concluded that leu- and met-enkephalins are released together with epinephrine from the adrenal meulla during stress as in the fight and flight reaction. The localization of leu-enkephalin in the periphery of the vas deferens and met-enkephalin close to the central lumen, may indicate that these peptles have different functions. For example, leu-enkephalin may modiate contractions of the outer muscle and maybe blood vessels presen in the sheet. Met-enkephalin may effect the inner layer and migt even be released into the lumen.

THE INFLUENCE OF SMOKING ON SALIVA COMPOSITION

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Saliva is a major factor in oral health. A change in salivary composition could result in complications in the oral environment. This project researched the influence of smoking on the composition of saliva which could in turn affect the health of the entire oral cavity.

The four salivary components analyzed were ascorbic acid, amylase, calcium, and phosphorus, which is needed to perform certain functions in the oral cavity. Saliva samples were taken from a panel of 59 smokers. The panelists attended 3 stop-smoking seminars in a 3 month period with saliva samples being collected after each. Nicorette was used by some panelists to aid in smoking cessation.

Each of the analyses performed required in-depth modifications of various assays for other body fluids to attain data for saliva composition. The ascorbic acid analysis utilized a major modification of the Roe method, while a modified Bernfeld assay was conducted for amylase, and the Weissman and Piuggi assay was altered to compensate for calcium and phosphorus in the saliva. With standard curves for each assay after each of the 3 time periods, data was collected, utilizing repeated t-tests and linear regression. Conclusions were drawn as to relative component alterations for each individual. The amount of ascorbic acid increased as smoking declined as hypothesized, while no changes occurred for amylase or the levels of calcium and phosphorus, which had been thought to decline.

This experiment was to expressly show the danger smoking brings to the oral cavity and not just to the lungs.

BETA-CAROTENE: A DISCUSSION OF ITS CHEMOPREVENTIVE BENEFITS

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The purpose of this project was to investigate the possibilities of using Beta-carotene (B-carotene) as a cancer chemopreventive agent. In this experiment the effects of B-carotene on the growth of chemically-induced preneoplastic lesions was studied. Thirty-two Fisher 344 male rats were injected with 200 mg/kg of diethylnitrosamine (DENA), a hepatocarcinogen. After four weeks the rats were given 2.0 ml/kg of 2 AAF for five days then 2.0 ml/kg of carbon tetrachloride (CCl_4) diluted 1:1 with corn oil. The animals were then gavaged with the same amount of 2 AAF for five more days. This protocol promotes the proliferation of DENA-initiated hepatocytes.

Two days after receiving the last 2 AAF dose the rats were fed a diet containing either 0%, 0.2%, 0.02% or 0.002% B-carotene. Animals were randomly assigned to the dietary groups. After six weeks the rats were euthanized and the livers were removed. Frozen liver sections were microscopically examined to determine the number of gamma-glutamyl transpeptidase positive preneoplastic lesions. A large number of foci was found in the 0.02% level of B-carotene in comparison to the other three dietary groups. This finding was unexpected since it had been hypothesized that there would be a large number of foci in the control group and a dose-dependent reduction in the number of foci in the groups receiving B-carotene. Since the animals were randomly assigned to the respective dietary groups these results suggest that a certain level of B-carotene may be a tumor promoter in a laboratory animal.

#ANTI-INFLAMMATORY EFFECT OF GUAIACUM SANCTUM ON INFLAMMATION INDUCED BY HISTAMINE AND SEROTONIN ON THE RAT HIND LEG

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To determine the effect of the extract of Guaiacum sanctum on inflammatory processess, the rat hind leg model was used. Inflammation of the paw of the Spraque Dawley Rats was induced by subplantar injection of 0.1cc of 15 mg/cc histamine or 0.1cc of 0.05 mg/cc serotonine. Pretreatment with cyproheptadine (3 mg/kg p.o.) significantly reduced the histamine and serotonin induced inflammation of the paw by more than 50 and 45% respectively. The histamine- and serotonin-induced edema was also significantly reduced by the extract of Guaiacum sanctum (Guayacan) by more than 60 and 30% respectively. These results indicate that the extract of Guaiacum sanctum (Guayacan) possesses certain anti-inflammatory activity.

#Third Award - General Motors ISEF

A STUDY OF
THE EFFECTS OF ALPHA TOCOPHEROL (VITAMIN E) ON MAMMARY ADENOCARCINOMA

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The effects of alpha tocopherol on a mammary adenocarcinoma were studied in this experiment. Four separate groups of C3H-Br laboratory mice, which are bred specifically for mammary cancer were used. Two groups were fed regularly, diets consisting of high amount of Vitamin E. One of these was used as a control group. The other was eventually injected with a mammary tumor. The remaining groups were given diets containing regular amounts of the vitamin. Again, one was a control group, the other was injected with the adenocarcinoma. After approximately three weeks, the mice were sacrificed and dissected. Tumor occurrence, size, and weight were compared.

The alpha tocopherol somehwat prevented and inhibited tumor appearance and growth in the group that received the vitamin. The sizes of these tumors were relatively smaller than those in the regular Vitamin E group. Alpha tocopherol proved to play a major role in prevention and inhibition of cancer growth.

INDUCTION OF DIFFERENTIATION AND MATURATION OF TUMOR CELLS IN TISSUE CULTURE

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Friend leukemia cells were induced to differentiate with various agents. DMSO and interferon resulted in the largest colonies. DMSO induction was augmented or reduced depending on dose of interferon. Dexamethasone and BUdR as well as SIBA and MTA inhibited differentiation. DMSO induction was augmented by adenosine 3-5 cyclic monophosphate as measured by Benzidine and PAP stains. db-cAMP, Con-A and interferon stimulated FLC to increased DNA synthesis and mitosis as measured by DNA histograms. Immature glioma cells were induced by db-cAMP to change to mature, differentiated astrocytes.
This study shows that immature cell lines can be used to study the process of induction and reversal of differentiation. The interference in the flow of information from DNA into cell proteins may be a cause of malignancy. Inducers such as DMSO and db-cAMP that were used in this experiment may influence parts of the genome of the malignant cell to allow for normal maturation.

#First Award - Tissue Culture Association
Fourth Award - General Motors ISEF

VITAMIN D AND ITS EFFECTS ON RATS

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Vitamin D is a general term for a group of compounds which exhibit vitamin D activity. Vitamin D_2 (ergocalciferol) is made by ultraviolet radiation of ergosterol. It is equally potent in humans as natural vitamin D_3.

Vitamin D is essential in normal bone growth, hardening, and repair of bone. Vitamin D works with the parathyroid hormones to regulate phosphorus and calcium metabolism.

Sunshine is an excellent source of vitamin D as well as foods such as milk, fish, egg yolk, yeast and lard.

Physical changes may be observed by feeding rats identical diets with the exception of vitamin D_2 being added to the control group's diet. Both groups were kept in an area free from sunlight. After 30 days the control group's weight had increased 133%-142% while the experimental group's weight only increased by 24%-86%. The greatest difference was between the female rats. When vitamin D_2 was added to the experimental diet the male rat's weight increased drastically but the female rat only increased her weight by 3%.

This experiment proves that vitamin D deficiency in male and female rats retards their growth rate. It also supports the fact that osteoporosis and other calcium related deficiency diseases are more common in females. The role of vitamin D in the absorption of calcium by the body is very essential.

FAST/SLOW TWITCH FIBERS AS LINKED TO PIGMENTS.

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The purpose of this project is to investigate the relationship, if any, between fast and slow twitch muscle fibers and the pigmentation of the eyes, skin and hair of the human body.

Individual males between ages 17 and 25 were selected at random and administered the vertical jump test. This test is used to determine the extent of explosive power possessed by people, which, in turn, relates to the existence of a majority of either fast or slow twitch muscle fibers throughout the subject's physical makeup. The results were correlated to pigmentation of each individual's eyes, skin and hair for the purpose of establishing a visual basis for predicting whether he possessed a predominance of one type of muscle fiber over the other.

The tests and correlations reveal 1) that certain pigmentation types are more predictable as to muscle fiber predominance than others, and 2) that most persons with dark pigments have a majority of fast twitch muscle fibers and thereby possess greater "sprint" type physical capacities, as compared with those having light pigments, who have a majority of slow twitch muscle fibers and thereby possess greater "endurance" type physical capacities.

This new test, the Pigment/Capacity Test, may now replace the physical biopsy and vertical jump tests for determining physical capacities of persons possessing certain pigmentation combinations. Practical application of this knowledge includes the areas of athletics, military manpower and the work place.

A COMPARISON OF MEDICALLY IMPORTANT HOUSE DUST MITE POPULATIONS IN THE ST. GEORGE UTAH AREA.

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It has long been known that populations of mites thrive in house dust. Many allergic reactions to house dust, including asthma, can be traced directly to the presence of these mites.

The purpose of this study was to investigate the populations of house dust mites in the St. George, Utah area, to see if their numbers indicate a possible health concern.

It was expected that the mild climate of St. George might offer a suitable habitat for large populations of mites associated with dust, thereby creating some concern for the inhabitants of this area.

Using a "Dustbuster" vacuum, samples of dust were collected from 30 different localities. All samples were reduced in size to 30cm^3 and placed in small Berlese Funnels. Mites driven from dust samples by heat were collected in culture dishes containing 95% Ethyl alcohol. Each alcohol sample was examined through a binolucar microscope and mites were removed, counted, and recorded. They were then mounted in hoyers solution and identified.

Mite populations proved to be variable, with high populations coming from older buildings and places where food is prepared. Samples from steril environments such as hospitals and doctors offices were found to have low populations.

When compared to the work of E.R. Tovey, who commonly collected over 1,000 mites in one gram samples of house dust, this research found mite populations to be extremely low in the St. George area, possibly due to arid environment.

#TROPOMYOSIN AND ALPHA-ACTININ IN METASTATIC CELL VARIANTS

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Actin is an important muscle protein that regulates motility in most eucaryotic cells, and is itself regulated by many actin associated proteins (AAP's) such as tropomyosin (TM) and alpha-actinin (AA). AA cross-links actin filaments into a gel meshwork; TM strengthens actin bundles and competes with AA for actin binding sites. Since organized actin is needed to maintain the motility characteristic of normal nonmuscle cells (NNMC), it is postulated that NNMC have more TM than AA, while metastatic cells have more AA than TM.

The above hypothesis was tested by measuring the quantity and organization of TM and AA in normal mouse spleen cells, slightly metastatic B16-F1 melanoma, and very metastatic B16-F10 melanoma using the indirect immunofluorescence technique. Two hamsters and one rabbit were injected with rabbit TM and chicken AA, respectively. After five months the animals were bled and using gel diffusion the sera were found to contain antibodies. The three cell types were seeded on cover slips, fixed, stained, and washed. The cells were then graded for fluorescent brightness under the immunofluorescence microscope on a scale of 1+ to 4+.

It was found that total and organized TM per cell decreased in the metastatic variants, but that total AA per cell remained constant while organized AA per cell increased in the metastatic variants. These results favor the motility theory of tissue invasion, support the AAP alteration theory of actin transformation, and emphasize the known roles TM and AA play in cell motility.

#Third Award - General Motors ISEF

#THE EFFECTS OF THYMIDINE ON THE ANTIVIRAL ACTION OF ACYCLOVIR

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Acyclovir is an antiviral drug which is active against herpes viruses. It is activiated by a viral-specified enzyme called thymidine kinase. The normal substance which viral thymidine kinase acts upon is the nucleoside thymidine. If acyclovir and thymidine are both present in the same cell, they might compete for the active site of thymidine kinase. It is hypothesized that increasing the thymidine in the cells will decrease the antiviral activity of acyclovir.

Plaque reduction assays were performed to test if acyclovir is more effective in certain cell strains with different natural levels of thymidine and to determine if increasing the amount of thymidine in the culture system would alter acyclovir's antiviral acitvity.

Two techniques of the plaque reduction assay were performed. However, only Technique 2 produced quantitative data. Five cell strains, Vero, 219D, BT, MDBK, and PK, were grown in tissue culture or in vitro, and inoculated with acyclovir concentrations ranging from .1-2000 mcg/ml. Although acyclovir did significantly decrease the number of plaques, a concentration above 2000 mcg/ml is needed to inhibit viral replication entirely.

The inoculation of thymidine increased the number of plaques in BT, MDBK, and Vero cultures.

Experimentation supported the hypothesis that thymidine would decrease the antiviral action of the antiviral drug acyclovir.

#Second Award - General Motors ISEF

#LYMPHOCYTE PROLIFERATION MEASURED BY TRITIATED THYMIDINE(^{3}H-TdR) INCORPORATION IN T-& B-LYMPHOCYTES AND THEIR RESPONSES TO METHOXYCHLOR

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The organochlorines are excellent insecticides for several reasons: environmental persistence, a broad spectrum of insecticidal efficiency and relative low cost. Unfortunately, the persistence causes biomagnification in the food chain as well as high residual levels in the body. The experiment proposes to evaluate the response of the lymphocyte proliferation when methoxychlor, an insecticide, is administered to rats, and also identify where the major site of action between the chemical and the biosystem is located. By taking blood from the rats, cultured mediums were set up and incubated for three days under a controlled atmosphere. At the end of incubation the cells were harvested and DNA precipitated. The proliferation was examined by the amount of ^{3}H-TdR incorporated in the DNA. This was done by liquid scintillation spectroscopy. It was found that the methoxychlor slightly effected the cell reproduction; therefore, depressing the lymphocyte proliferation response. The higher the relative proliferation index, the more elevated the lymphocyte proliferation. The relation between the control and treated cultures was expressed in % change. The higher the % change, the more depressed the lymphocyte proliferation response between treated and controlled cultures. The methoxychlor depressed the lymphocyte proliferation and thus the cellular reproduction. However, the majority of the stored methoxychlor is located in the neurological areas or the adipose tissues, and does not react with the lymphocytes with great prevalence.

#Fourth Award - General Motors ISEF

THE EFFECT OF NIFEDIPINE ON CHRONIC STABLE ANGINA PECTORIS

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Nifedipine is an antianginal drug belonging to a relatively new class of pharmocological agents called the calcium antagonists. They are most often prescribed to patients suffering from the crippling chest pain of angina pectoris, an ischemic heart disease, and have recently become very popular. Nifedipine, sold by by Pfizer Inc. as PROCARDIA, is often more effective than other antianginal medications such as beta blockers or long-acting nitrates. Like most calcium antagonists, Nifedipine is known to cause a variety of side effects. There has been concern among many doctors about how they affect hormone levels and certain body functions. This experiment involved the study of a group of angina patients who had been using Nifedipine as their only antianginal medication for one year. Patients were asked to observe the frequency of their attacks, their severity, and their length. They were also asked to record their sublingual nitroglycerin usage and the effect of their anginal episodes on daily activity. Blood tests and blood pressure before the initiation of Nifedipine and one year later were compared to determine the effectiveness of Nifedipine. Many undocumented side effects were noted. It was found that although some patients still experienced attacks of low severity, the frequency of angina attacks was reduced in most cases by over 70%. The lengths of the patients' attacks were also diminished. Slight elevations of some hormone levels, particularly of SGOT, were seen, but they did not exceed the normal range. Some hypotension was encountered, but blood pressure was safely regulated by titration of the drug. It appears that Nifedipine is extremely effective in angina treatment and, although it causes numerous side effects, its benefits dwarf its drawbacks.

#THE EFFECT OF NARCOTIC ANTAGONIST ON "JOGGER'S HIGH"

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Most people today like to exercise. Many say it makes them feel better. Scientists call this the "jogger's high." It is believed that this could be related to chemical compounds produced in the brain called endorphins. These are released when you exercise and could be the cause of "jogger's high". The purpose of this four year project is to determine if endorphins are the cause of "jogger's high".

Three groups of four mice were used in this experiment. First, they were each put into a gerbil wheel and allowed to exercise as much as desired for five minutes. The number of times the wheel turned was counted and recorded. Control Group #1 always stayed in their cage. Control Group #2 was exercised daily for two weeks. The Experimental Group was also exercised daily for two weeks, but received a dose of 0.01mg Narcan per kilogram body weight immediately prior to exercise. At the end of the two weeks, each mouse was again placed in the gerbil wheel and had the choice to exercise. The number of times the wheel turned was recorded. During this time their weights and amount of food consumed was recorded.

The experimental group chose to exercise about the same as the Control Group #1 did, but the Control Group #2 showed a dramatic increase. These results support the hypothesis that endorphins are the cause of "jogger's high."

#Fourth Award - General Motors ISEF

SOLVING THE PROBLEM OF EQUINE DENTISTRY

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PROBLEM: What effect do diet and age have on dental decay in horses? HYPOTHESIS: I hypothesize that older horses will have more plaque than younger ones, and horses fed alfalfa hay will show more evidence of plaque than horses fed pasture grass. PROCEDURE: 1- Locate horses of various ages and diets. 2- Obtain plaque disclosing solution from a local dentist. 3- Spray solution into horses' mouths. 4- Rinse excess solution off of teeth. 5- Document results with photos. CONCLUSION: I conclude that the contents of alfalfa cause more oral plaque than pasture grass, and generally older horses have more plaque than younger ones. PROBLEM:(phase 2) Can dental plaque in horses be controlled through the use of non-toxic chemicals? PROCEDURE:(phase 2) 1- Obtain plaque and saliva specimens from various horses. 2- Prepare 8 petri dishes with nutrient agar. 3- Inoculate agar with specimen samples. 4- Incubate for 72 hours. 5- Inoculate specimens with various non-toxic chemicals. 6- Record results through microphotography. CONCLUSION:(phase 2) I conclude that many non-toxic chemicals may be used to retard the growth of plaque. However, conventional human solutions are not as effective as the combination of cetylpridinum chloride, sodium fluoride, and bicarbonate of soda. APPLICATION: When horse's teeth are improperly cared for, they become subject to caries, peridontal disease, and rot, through the use of sodium fluoride, cetylpridinium chloride, and bicarbonate of soda in a mixed rinse.

THE EFFECTS OF EXERCISE, PROBUCOL, AND CHOLESTYRAMINE ON CHOLESTEROL LEVELS IN MICE

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An elevated serum cholesterol level is an established risk factor in coronary heart disease. This fact has prompted much research to find methods of lowering the cholesterol level. One commonly used method is through the administration of cholesterol-lowering drugs. In addition, exercise is helpful in raising the high-density lipoprotein level, which plays a crucial role in the prevention of atherosclerosis. This research project investigated the effects of exercise on the action of the two cholesterol-lowering drugs, Probucol and Cholestyramine. Five groups of seven mice were used: a control group, two drug groups, and two drug with exercise groups. Cholesterol levels were determined after seven weeks, using Dow Enzymatic Cholesterol Reagent Kits. Probucol, as expected, lowered cholesterol levels 54% and 49% in the LDL and HDL cholesterol fractions respectively. When exercise was added in addition to the drug, the cholesterol levels were reduced in both fractions an additional 30% and 25%. Due to the low fat intake of the mice, Cholestyramine did not produce its expected effect. LDL levels were unaffected, whereas HDL levels rose in both Cholestyramine groups. The LDL/HDL ratio fell 14% and 22% in the Probucol and Cholestyramine groups, with additional falls of 24% and 4% as a result of exercise.

MAKING CALORIES COUNT

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The purpose of this experiment is to determine which is more beneficial to weight loss - crash dieting or normal (reduced calorie) dieting with an induced exercise plan. This subject was chosen because of an interest in the field of weight loss and calories. Also, a desire to, in the future, advance in the field of health and medicine.

Four subjects, two males and two females, were put on selected diets. One male and one female were put on a crash diet and one male and one female were put on a normal, healthy diet with exercise. The calorie intake and weight loss were recorded daily. It was found that the weight loss of the crash dieters followed a yo-yo type pattern, increasing and decreasing regularly with the male's weight loss varying less than the female's. The regular dieters' weight loss was more steady, varying hardly at all.

CONCLUSION: Crash dieting drops more pounds for only a short period of time - then gains at a more rapid rate while a moderate calorie cut plus exercise continues to gain ground in weight lost with less gained back in the long run.

VITAMIN C LOSS IN BEVERAGES

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The content and relative oxidative loss of vitamin C was compared in several commercial beverages. Known molar values of vitamin C from crushed ascorbic acid tablets (500 mg and 250 mg) were used as controls. Content was determined by titration, using indophenol as an indicator. All comparisons are relative only, but indicated different levels of vitamin C in each beverage (one beverage indicated no vitamin C). Each beverage was kept uncapped and was agitated on day 3 to facilitate aeration. All beverages containing vitamin C lost vitamin C over a 6-day period; each lost at least 50% of its vitamin C content.

BLOOD PACKING

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Blood packing is a technique used in sports medicine believed to increase an athlete's endurance. Blood is drawn from the athlete; the cells are separated from the plasma by centrifugation and stored. Prior to the event, the cells are reinjected. The object is to raise the red cell concentration, mimicking the bloodstreams of people living at high altitudes where less oxygen is present in the atmosphere. A greater red cell concentration increases the blood's oxygen saturation capacity and the amount of oxygen available in the bloodstream. This experiment attempts to duplicate the effects of blood packing in an animal. The main aims are to observe respiratory rate and to determine how long the effect lasts. The respiratory rate should slow while the blood is packed, but the amount of oxygen used in each breath should increase, since there are more cells to saturate. The subject of the experiment, a cat, was tranquilized; a quantity of its blood drawn and centrifuged, leaving plasma and solids. The solids, mostly red cells, were transfused into the same cat. Red cell count and respiratory rate were recorded until they had returned to normal. The respiratory rate slowed as expected. The cell count climbed after the injections and did not return to normal levels until approximately the twentieth day. According to the data gathered the respiratory rate varied inversely to the red cell concentration.

THE EFFECTS OF COMBINING ANTIBIOITCS AND ENTERAL NUTRITIONAL SUSPENSIONS ON ANTIBIOTIC ACTIVITY- PHASE TWO

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The effects of combining antibiotics with enteral nutritional suspensions on antibiotic activity were studied. Research was divided into two phases of experimentation. In Phase One, eight antibiotics were divided into three groups: the antibiotic mixed with distilled water (the control group), the antibiotic mixed with Ensure (a type of nutritional supplement), and the antibiotic mixed with Osmolite(another type of nutritional supplement). These groups were tested for antibiotic activity by agar diffusion assay. Escherichia coli and Staphylococcus aureus were used. Results showed that of the eight drugs tested, cephalexin, doxycycline, tetracycline and Bactrim exhibited a significant decrease in antibiotic activity after being mixed with nutritional supplements.

A second phase was devised to verify conclusions. Doxycycline was divided into a control group and experimental groups. These groups were then tested for antibiotic activity by tube dilution assay. Results showed no significant decreases in antimicrobial activity after doxycycline was combined with the nutritional supplements.

A third procedure was developed to further verify conclusions. Doxycycline and tetracycline were divided into control and experimental groups. These groups were placed individually in semi-permeable membranous bags. The bags were placed in flasks of water, which were automatically stirred. Samples of the solutions outside the bags were taken at 1, 5, and 18 hours after the bags were placed in the water. The samples were then assayed for antimicrobial activity. Results showed a decrease in activity of both drugs after nutrient mixture.

A COMPARATIVE ANALYSIS OF THE RELATIONSHIPS BETWEEN BODY FAT, REACTION TIME, SOMATOTYPE, AND VITAL CAPACITY IN FEMALE ATHLETES

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The purpose of this project was to determine that: (1) A relationship exists between body fat and somatotype. (2) A person with lower body fat will have a lower vital capacity; conversely, a person with higher body fat will have a greater vital capacity. (3) A person with lower body fat will have a faster reaction time than a person with higher body fat. (4) A person with a faster reaction time will have a higher vital capacity than a person with slower reaction time. (5) An ecto-endomorph will have the faster reaction time, while an endo-mesomorph will have a slower reaction time. (6) An endo-mesomorph will have a higher vital capacity than a meso-endomorph.

Thirty-seven girls from five Northwestern Ohio varsity basketball teams were tested in the following four physiological parameters: skinfold measurements - used to determine percentage of body fat; reaction time - used to determine time of response with visual and auditory stimulus on dominant and non-dominant hand; body measurements - used to determine somatotype rating; and vital capacity - used to measure the maximum amount of air that can be expelled from the lungs after maximum inspiration.

The Pearson product-moment coefficient of correlation showed a high positive correlation, (.9316), between body fat and visual reaction time. The highest degrees of correlation exist between reaction time and vital capacity. All four reaction groups had consistently high, (⁻.9029 - ⁻.9935), coefficients, showing a strong inverse correlation.

EVIDENCE THAT THE SIZE OF MYELINATED FIBERS IS AFFECTED BY THE PERIPHERAL TISSUE THEY INNERVATE

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The purpose of this experiment was to test the hypothesis that the growth of myelinated nerve fibers that innervate a muscle is influenced by a signal sent by that muscle. Others' work shows that there is no difference between a nerve to a tenotomized muscle and a nerve to a normal muscle (Beranek et al. 1963). This indicates that if there is any stimulus sent by the muscle it does not affect mature nerve fibers. But, if the nerve had to develop without the signal, the reformed nerve might be affected by the lack of the signal. In this experiment four groups of adult female rats were used. The rats in group A had tenotomies done to the tendons of the medial head of the gastrocnemius muscle in the left leg and a sham tenotomy in the right leg. Group B had lesions done to the nerves to the medial head of the gastrocnemius muscle, as well as tenotomies, on the left leg and sham tenotomies and lesions on the right leg. Group C had nerve Lesions on the left leg and sham lesions on the right leg. Group D had no surgery. The rats were then left for four months; after that time the nerves were removed and sectioned. The sections were photographed and the diameter of each myelinated fiber was measured. The nerve fibers in the group with the tenotomies and the normal group were about the same size. These findings fit well with those of Beranek et al.. This means that a change in the amount of any signal from the muscle does not affect the size of fully grown nerves. After the tenotomy and nerve lesion, myelinated fibers were regenerated to a lesser degree than the nerve fibers with just the lesion. This may mean that the intact muscle sent a signal to the nerve that had an affect on the growth of the nerve, but the signal from the tenotomized muscle was impaired.

THE EFFECTS OF GARLIC OIL ON HYPERTENSION PHASE II: ISOLATION AND IDENTIFICATION OF THE ACTIVE COMPONENTS

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High Blood pressure has long been a health problem for humans. Ancient Egyptians reported the use of garlic as an effective remedy for many ailments including heart problems. Thus, this project was designed to isolate and identify the active antihypertensive component in garlic oil and then to test the component(s) in spontaneously hypertensive (SHR) rats. Thin layer chromatography (TLC) was initially used to separate the oil. Column chromatography was then used to obtain oil extract samples. These samples were tested by TLC. With 60 mg/kg of pentabarbital intraperitoneally, each rat was then canulated in the femoral artery and connected to a manometer. A control group was run to determine pentabarbital effects on blood pressure. The initial readings on all animals served as a control. Experimental animals, following an initial reading, received 0.10 ml of the garlic oil extract in ethanol/water. Blood pressure values were then recorded at 10, 30, and 60 minute intervals.

Results reveal that the anesthetic used slightly depresses blood pressure, requiring experimental values to be adjusted by 10.0%. Garlic oil extract #1 depresses systolic blood pressure an average of 4.3% which is not significant using the student t test. Extract #2 produced a mean blood pressure reduction of 25.2% following adjustment. This is significant at the 0.05 level. Data suggest that the active antihypertensive components of garlic oil can now be isolated, a previously unreported fact. Thus some garlic oil extracts may have potential in the treatment of hypertension.

#Second Award - General Motors ISEF

NATURAL VS. ARTIFICIAL BLOOD: ABILITY TO RELEASE OXYGEN

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The purpose of my project is to determine if normal human red blood cells are more efficient than hemoglobin solution and perfluorochemical emulsions in releasing oxygen to the tissues.
I tested my blood, three synthetic blood controls-acidosis, alkalosis, and normal, and a hemoglobin solution on a Blood Gas Analyzer. Using a tonometer to add oxygen to the samples, I oxygenated them for three different time limits - one minute, two minutes, and five minutes. After all samples had been oxygenated, I tested them on the Blood Gas Analyzer. The sample of my blood increased between one and two minutes and then decreased. The first sample is similar to the alkalosis and normal synthetic blood controls, and the 1:10 ratio of the hemoglobin solution because the amount of oxygen decreased. Sample number two of my blood is similar to the acidosis and straight hemoglobin and 1:1 ratio of the hemoglobin solution. The normal synthetic control and the 1:1 hemoglobin solution were used to compare the rate of oxygen released from natural blood. Each sample was oxygenated for five minutes and a reading was taken after one minute, three minutes, and five minutes to determine the amount of oxygen remaining in the samples. By comparing the beginning and ending amounts of oxygen, I was able to determine if the samples were capable of releasing oxygen.
My results show that the oxygen carrying the capacity of artificial bloods are similar to human blood. However, the artificial bloods may not be capable of supplying an efficient amount of oxygen to the body tissues.. The hemoglobin solution releases the oxygen faster than the normal synthetic control, however, the amount released shows that the solution may not be as efficient as natural blood.

#Fourth Award - General Motors ISEF

EFFECTS OF SUGAR SUBSTITUTES L-929 MOUSE FIBROBLAST CELL LINE

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Researchers have often challenged sugar-substitutes for their nutrional value and safety. Current substances undergoing testing include aspartame, cyclamates, and saccharin. Effects of aspartame, saccharin, and cyclamates on cellular toxicity and cell number in culture are being investigated through cytogenetic evaluations. Limited dose-response curves were established using pharmacological concentrations based on the concentration of the agents used in marketed products. Two controls were used, one containing only medium and the other containing 5% sucrose and medium.

The hypothesized result is that aspartame will not alter the growth of the L-929 Mouse Fibroblast cell line while both saccharin and cyclamates and their combinations with aspartame will.

The testing involved uses L-929 Mouse Fibroblast cell line and combines pharmologic concentrations of the substances with the medium (ALPHA MEM with 10% fetal calf serum and 100u penecillin/streptomycin).

The cellular toxicity is determined through both a dye exclusion test using the vital stain trypan blue with the viability count made with a hemocytometer. The number of alive cells, noted by not absorbing the trypan blue stain, was divided by the total number of cells to determine the percent of alive or viable cells. The number of cells grown per well was determined using a coulter counter. This electronic cell counter used isotonic buffered saline solution and 1.0ml of the titurated cell suspension.

#First Award - United States Army

A STUDY OF THE EFFECT OF HOT AND COLD EXTRACTS OF THE PLANT PEPEROMIA PELLUCIDA (L.) ON MUS MUSCULUS.

Soto, Víctor M., Dr. Efraín Sanchez Hidalgo H.S., Moca, P.R. 00716; Reparto Añeses, Moca P.R. 00716.

Among the plants classified by folklore in Puerto Rico as medicinal plants, there is a small but robust and highly branched plant that has a transparent appearence and normally reaches 1 to 4 decimeters in height. The plant grows well in humid and shadowy areas. The leaves are membranous with a deltoid-oval shape. The flowers are very small and produce in spikes. It produces very small fruits which fall off from the plant with relative ease. The same holds true for its flowers. The plant is scientifically known as Peperomia pellucida (L.) HBK. and belongs to the pepper family, the Peperaceae.

The plant is locally known under the common name peletaria, alumbre, frescura and clocaria. It is used in Puerto Rico for medicinal purposes as a diuretic. It is given the property of dissolving renal calculi and is also used as an aid to digestion and to stimulate appetite. It is used in two forms: as a tea and as a fresh water extract. In this last instance the plant is collected, placed in fresh water, cooled and after a while used as a drink which is supposed to "freshen up" the body of the patient.

Practically no research work has been done on the medicinal properties of this plant if any. Nuñez Melendez (1982) gives medicinal properties but these are apparently based on folklore. This investigation attempts to determine if the extract of this plant affects the growth pattern of male and female Mus musculus and if it may produce sterility in this species.

Results show growth and behavior are affected by heated extracts of plant. It hinders the reproductive process by preventing gestation process. Ovaries of experimental females show deformation. Testicles of experimental males show abnormal sperms. Cold water extracts show no damage. Results were analyzed using Sorensen's Coefficient.

A HISTOLOGICAL AND PHYSIOLOGICAL STUDY OF THE EFFECTS OF DIETARY FIBER ON MUS MUSCUS

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The purpose of this experiment was to test the effects of diets with varying amounts of fiber on mus muscus, with particular attention to transit time. Three groups (low-fiber, high-fiber, and control) were fed continuously and given water every 3-5 days. The feces, urine, and blood were tested by different methods. The mice were weighed and the activity levels were observed. Electron micrographs of the feces were made, and cross-section slides were made from the large intestine of the mice. The high fiber group and the control group had a high quantity of feces which shows a faster transit time. The low fiber group had a low quantity of feces which shows a slower transit time. The faster transit time of the high fiber group allowed the greatest food and water intake over the other two groups. The feces of the high fiber group had the greatest weight, strongest odor, and lightest color. The urine of the high fiber group was the darkest and had the highest NaCl content. There was little difference in the pH levels and the odors of the three groups. Blood cell structure appeared unchanged but the haemoglobin weights increased slightly in all groups, possibly due to the vitamin supplement. The low fiber group was the most active perhaps due to the slower transit time which allowed more nutrients to be absorbed. The low fiber group had the largest livers and the most stored fat which also may have resulted from the slower transit time. The cross-section slides made from the colon and rectum of the three groups showed a difference in the thickness of the longitudinal muscles. The high fiber group had thin muscles while the low fiber group had thick muscles. The thick longitudinal muscles most likely formed from having to force the waste materials from the body due to the lack of fiber.

BIOLOGICAL, CHEMICAL AND HISTOLOGICAL'S STUDIES IN VIVO ABOUT ANTI-CANCER ACTIVITY OF ARGEMONE MEXICANA L. IN MUS-MUSCULUS

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The present study was undertaken to evaluate the antitumor activity of different extracts of the plant Argemone mexicana L. The following extracts were tested: extract #1 consisted of roots in 50% ethanol exposed five days to solar radiation; extract #2 consisted of leaves and stems in distilled water; extract #3 was prepared as extract #1 but was not exposed to solar radiation. The antitumor activity of the extracts was tested with Ehrlich Ascites tumor cells grown in male white mice strain C-D-1 (Mus-musculus). The forty mice were intraperitoneally inoculated with 10^5 Ehrlich Ascites tumor cells per mice. Forty-eight hours after inoculation mice were divided into four groups of ten mice each. Group #2 serve as tumor control, group #3 mice were treated with extract #1, group #4 was treated with extract #2 and group #7 was treated with extract #3. Group #1 serve as uninoculated control and groups #5, #6 and #8 as toxicity control for the different extracts. The treatment with the extracts started forty-eight hours after tumor implant and consisted of every day intraperitoneal injections of 0.1 ml of the indicated extracts. Roots extracts tested protected 50% of the animals. The water extract of leaves and stems protected 80% of the mice. Histological studies showed no tumor in the organs of the treated animals. The active fraction in the extracts are under study for its identification using thin layer and gas chromatography and nuclear magnetic resonance. No animal toxicity was shown by any of the extracts tested.

Can Staphylococcus Aeueus Be Energy Efficiently Controlled in Laundry?

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The purpose of the project was to develop an energy efficient cold water laundry method, sanatizing hospital laundry againts staph, removing stains, while maintaining a non-irritating non-damaged finished product. Quaternary Ammonium Chloride was used as a common agent. Varying strenghts of solutions were used ranging from the amount needed to destroy staph to two, three, four, and five times that amount. A ratio of linen to water was used based on the acceptable hospital standard of 4.5 gallons of water to 1 pound of linen. Samples of cotton material were laundered in each of the five solutions and a test of strength was made by applying the necessary weight to tear the material. Stains of blood, betadine, and petrleum jelly approximately 2 cm in diameter were applied to samples of cotton and polyester-cotton materials and laundered in each of the five solutions and a control.

The Quaternary Ammonium Chloride showed no weakening effects on the material when used at regular strength. The blood stains were removed in the control which was 16 C tap water. The betadine stains were removed in the control which was 16 C tap water. The petrolem jelly stain was not completely removed in any solution, but was removed when a degreasing agent was applied directly to the stain.

A six cycle wash was arranged using rinse, Quaternary Amminium Chloride, detergent, bleach, rinse, and sour, to achieve a pH of 6-7, eliminating alkaline skin irritants in the laundry and allowing for a prolonged shelf life.

#Second Award - United States Air Force

"A CURE FOR ARTHRITIS?"...PHASE 1: IN SITU FIELD STUDIES

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Saccharum officinarum, or sugarcane, contains many nutrients that are useful to the body(Jones,1929-36). This study investigated whether these nutrients preserved in cane syrup can affect arthritis and other human disorders.

Previous research(Jones,1929-36) indicated that the components of sugarcane could be preserved in cane syrup. Steen's Pure Ribbon Cane Syrup was chosen as the carrier to be studied because tests proved that it contained ash(calcium, potassium, and similar elements) in more significant quantities than the other syrups tested.(Cajun Sugar Co-operation laboratory)

In the primary field study two subjects were interviewed who had been daily consuming a Steen's syrup and lemon mixture. Six additional subjects were administered daily dosages of one tablespoon of the mixture or only the syrup depending on the condition. Pre-experimental and post-experimental interviews and studies of the results were conducted.

It was concluded that there are indications that the Steen's Pure Ribbon Cane Syrup can prove to be a useful factor in the relieving of arthritis, prevention of fatigue, and improving of overall physical health.

The conclusion to the field study indicated that there were grounds for a critical experiment involving animal and later human subjects with precise controls present in order to determine a precise relation.

A COMPARATIVE STUDY OF WEIGHT AND ACTIVITY DUE TO HIGH DENSITY DIETS IN SPRAGUE DAWLEY ALBINO RATS

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This research was done to investigate how diets of concentrated protein, sugar, and fat effect the weight, physical activity, and pulse rate in Sprague Dawley albino rats. The hypothesis is a result of library research which showed high protein diets could cause weight loss and even death. It was also found that a high sugar diet could supply much energy and should help build muscle tissue since adequate energy producing sugar would prevent the break down of muscle tissue for energy production. Research showed that a high fat diet could cause considerable weight gain and posible high blood preasure. Activity would likely increase with high protein and high sugar diets and the activity should decrease on high fat diets. Pulse rate should increase with all three.

Five rats per group were each A)fed:1) Sugar group: gg. sugar + 20 ml water solution + 1 chunk rat chow. 2) Protein group:6g. Meritene protein supplement + 20 ml. water solution + 1 chunk rat chow. 3) Fat group : 4 rat chow chunks saturated in Crisco oil. 4) Control group: 6 chunks rat chow. B) Each was weighed every second day. C) Each was tested for activity by counting the squares contacted in two minutes. D) Pulse was taken. after the activity was completed.

The high fat rats gained the most weight, were least active, and had higher pulse rates. The high sugar rats lost weight, were most active, and averaged the highest pulse rates. The high protein rats lost the most weight, were as active as the controls, and pulse rates were slightly higher than the controls. These results indicate that each diet could be harmful if continued.

THE USE OF INDOMETHACIN AS AN ANTAGONIST OF ACUTE PRENATAL ALCOHOL EXPOSURE IN C57/BL6 MICE

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HYPOTHESIS: Indomethacin antagonizes ethanol's teratogenic actions in C57/BL6 mice, therefore decreasing the incidence/rate of malformations, resorptions, increasing fetal weight and crown-rump length.

PURPOSE: The purpose of this study was to investigate the hypothesis that Indomethacin (a potent prostaglandin inhibitor) would antagonize the teratogenic actions of Ethanol in C57/BL6 mice.

PROCEDURE: 60 pregnant female C57/BL6 mice were randomly divided into four groups: Saline-Ethanol, Saline-Isocaloric saline, Indomethacin-Ethanol, Indomethacin-Isocaloric saline. On gestation day 10, mice were injected with either saline (.9 g NaCl in distilled water) or Indomethacin (5.0 mg/kg, .025 ml/g). Two hours later, they were injected with ethanol (3.5 g/kg, 20% w/v with .9 g NaCl) or an isocaloric-saline solution (sucrose-paired-caloric). On gestation day 18, fetuses were removed by caesarean section, weighed, measured, and stored in Bouin's fixative for a blind teratological evaluation.

RESULTS: The results demonstrated the intraperitoneal administration of ethanol resulted in a higher resorption rate, a higher percent of malformed pups per litter, and decreased fetal weight and crown-rump length. However, Indomethacin pretreatment significantly reduced the resorption rate, percentage of malformations, and increased fetal weight. Peak blood alcohol levels were not significantly different (Saline-Ethanol 402±21 mg/dl, Indomethacin-Ethanol 447±18 mg/dl-mean ± S.E. $p>.05$).

CONCLUSION: Because one of the primary pharmacological actions of Indomethacin is the inhibition of prostaglandin (PG synthesis), it is possible that PGs mediate the teratogenic actions of alcohol.

TUMOR INHIBITION BY HYDROCORTISONE

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The purpose of this project was to see if heparin in the presence of hydrocortisone would inhibit tumor growth. The research was performed at the University of South Florida under the direct supervision of Dr. Jaime Estrada.

The study was carried out in the following fashion. Twenty rats were injected with MT-F7 tumor cells (female rat breast cancer) and the growth of the tumors was observed for two weeks. At two weeks the rats were started on their designated treatments (note the amount of treatment that was in the water was determined by the water consumption of the two rats in each cage) and the rats in the first control group were sacrificed to provide a basis of comparison for the other groups. The tumors of the other rats in their treatments were observed for three more weeks, at which time the rest of the rats were sacrificed.

The results were compiled and the following conclusion was determined. Heparin alone helped the tumor to grow. Hydrocortisone alone did inhibit tumor growth, and its effects on the tumor caused it to regress partially. The test group that had both heparin and hydrocortisone inhibited tumor growth and caused partial tumor regression, but the results were not as good as the results from the test group containing hydrocortisone alone. Therefore I conclude that hydrocortisone was the chemical that inhibited tumor growth and caused the tumor to regress partially.

A TWO YEAR STUDY OF THE EFFECTS OF ULTRASOUND ON GROWTH AND DEVELOPMENT

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In view of the widespread use of ultrasound in medicine, industry, and the military, the purpose of this research is to determine the possibility of the detrimental effects of ultrasound on the growth and development of several species of plants and a specific genus of fish. Because previous research has not established the effects of ultrasound on the male reproductive system, this research also investigates these effects on the development of the male reproductive system of a specific amphibian.

Phase I of the experiment led to the conclusion that ultrasound affects the growth and health of various plants by disrupting the photosynthetic system.

Phase II involves a study of the embryonic development and juvenile behavior of Oryzias latipes. After exposure to various frequencies of ultrasound, observations of the developmental process were made and compared to a control group. Abnormalities in development were observed at all frequencies, some juvenile behavioral abnormalities were observed, but a high mortality rate did not occur.

Phase III studies of the male reproductive system of Rana pipens investigates sperm production and mortality, and seeks to determine the possibilities of abnormal development.

#First Award - United States Air Force
Fourth Award - General Motors ISEF

A STUDY OF HEATSTROKE AND IT'S EFFECTS ON BLOOD CHEMISTRY -YEAR II

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This project is composed of two years of research. The first year's research dealt with finding a more effective treatment for heatstroke than those means by which it is treated today. This therapy involves the injection (intraperitoneally) of FC-43 -a perfluoro-chemical-type blood substitute. Two groups of rats were used in these experiments, treated and untreated. The rats were first anesthetized and then slowly heated stimulating heatstroke. The treated group received it's injection at 40°C (105.8°F). The rats were heated to progressing predetermined temperatures. Once reached, the rats' chests were opened to remove approximately lcc of blood from the rats hearts' left ventricle. The blood was then tested for oxygen retention. The results showed that the treated rats had an average of 30.9% more oxygen in their blood than the untreated rats.

The second year's research was concerned with finding out what caused the temporary "protective effects" of the FC-43 injection. Three groups of rats were used in these experiments: FC-43 injected rats, saline injected rats, and rats left untreated. Each rat had a catheter implanted in it's left carotid artery. They were then heated until in heatstroke. Three to four blood samples were removed from each rat and tested in a blood-gas machine. If the rat was to receive an injection, it did so upon entering heatstroke (40°C). Blood samples were taken and tested along with the rats' heart rate and blood pressure. The results showed the lactate samples to increase in intensity with temperature but were less in the treated groups indicating the blood-expanding characteristics of the injections.

#London International Youth Science Fortnight - United States Marine Corps

THE EFFECT OF FOLINIC ACID UPON THE CYTOTOXICITIES OF FLUORINATED PYRIMIDINES IN HEp-2 TUMOR CELLS

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Initially, it was discovered that tumor cells divide more rapidly than normal cells; therefore, tumor cells need to synthesize increased grades of DNA and possess elevated levels of the enzyme thymidylate synthetase (T.S.). These basic differences between normal cells and tumor cells have been exploited in tumor cell chemotherapy with fluoropyrimidines. Since T.S. requires folinic acid (F.A.) to form thymidine 5'-monophosphate (dTMP), it was hypothesized that increased exogenous folate pools would result in an overall increase in the cytotoxicities of fluorinated pyrimidine analongs. HEp-2 cells were trypsinized, grown on tissue culture plates, and incubated for twenty-four hours. Eagle's Minimal Essential Media containing fluorinated pyrimidines were then added. After a forty-eight hour incubation, the cells were rinsed with phosphate buffered saline, trypsinized, and serially diluted. Following a seven day incubation period, all cells were dyed with crystal violet stain to determine the colony forming ability of the cells under the controlled conditions. The addition of F.A. increased the cytotoxicities of FdU and FdC+H_4U upon HEp-2 cells although it did not effect the cytotoxicities of the other fluoropyrimidines tested, FUra and F_3Methyl dC+H_4U. F.A. actually decreased the prevention potency of FUra, while F_3Methyl dC displayed an expected zero effect. I concluded that the addition of folinic acid does increase the cytotoxicities of certain fluorinated pyrimidines, thus inhibiting the extension of tumor cells.

THE CANINE ALLERGY-OBESITY CONNECTION

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My observation that growing numbers of individuals are plagued both by ecological illnesses and weight problems, led me to wonder whether allergies might predispose one to obesity. I decided to test this hypothesis using a sampling of dogs.

I developed a set of criteria to evaluate the allergy and weight status of my canine test population. I formulated a list of allergy symptoms, which I itemized on a questionnaire. If two or more of these indicators were present, I diagnosed the dog as allergic. I also compared the dog's weight to established breed norms. I then did a simple pinch test on the spine and ribs to determine the body fat content. If the weight was 15% above average, I classified it as overweight, and if it was 20% above average, it qualified as obese or overfat.

After testing 50 dogs, I found that the majority of allergic dogs had weight problems. I hypothesize that an elevated level of immunoglobins (especially IgE) present in allergy sufferers suppresses the metabolism. My data showed that of the 44 allergic dogs, 30 or 68% were overweight and or overfat. Of the 6 normal dogs, 2 or 33% were overweight and or overfat.

In conclusion, I feel I have shown a possible connection between allergies and obesity in dogs. This theory might be applied experimentally by treating grossly obese animals for allergies to reduce their IgE level, thereby returning the metabolism to a more normal state. If this were successful, the same treatment could be applied to humans to bring them into a healthier weight range.

#First Award - American Veterinary Medical Association

#EFFECT OF ASPARTAME ON NEUROTRANSMITTER SEROTONIN: HOW IT INFLUENCES FOOD CONSUMPTION IN MUS MUSCULUS

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It is a recent theory that aspartame (*NutraSweet) may actually increase hunger, therefore being of no use to people trying to control their weight. The neurotransmitter serotonin, located in the brain stem, is responsible for controlling the nerve impulses in the monitoring of hunger. I hypothesized that aspartame inhibits the production of the neurotransmitter serotonin, and thus, increases or maintains a subject's hunger potentially causing a gain in weight. I attempted to prove this hypothesis by comparing weight gains of mice given 5ml of a .5% aspartame solution daily with those of mice given 5ml of tap water daily. The relative amount of serotonin in the urine was also compared to determine if aspartame actually inhibits the production of serotonin to some extent and, consequently cause an increase in hunger. After a three month testing period, the average weight gain of the experimental mice was 18g per mouse, wheras the average weight gain of the control mice was only 10.8g per mouse. The relative amount of serotonin in the urine of the experimental mice was slightly lower than the control mice, further supporting my hypothesis. These results support my hypothesis that the use of aspartame may actually increase hunger and lead to a gain in weight.

#First Award - Eastman Kodak Company
First Award - United States Navy/Office of Naval Research

#Compounds in Ascitic Fluid: Effects on Oxygen Free Radicals in Mouse Peritoneal Macrophages

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This study is concerned with the effects of a low dalton compound in ascitic fluid, from the peritoneal cavity of cancer patients, on the production of oxygen free radicals in mouse peritoneal macrophages.

The ascitic fluid was purified through column chromatography, and the fractions applied to the macrophages in the superoxide anion and hydrogen peroxide assays. Low dalton constituents in ascitic fluid was found to stimulate the production of the free radicals superoxide and hydrogen peroxide in mouse macrophages. Whether this stimulation is produced by the host cells or tumor cells remains to be determined. If the tumor cells are responsible for this stimulation, its suggested function would be to destroy the host cells by activating the macrophages to produce oxygen free radicals. If the stimulating factor is produced by the host cells, its purpose would be to destroy the tumor cells. The production of oxygen free radicals was found to be stimulated in the first three hours of incubation, after which they began to decrease. The stimulus in ascitic fluid is present at high concentrations but it appears to be more active when the fluid was diluted. With further studies, this information may be used in treating patients with ascites by varying the concentration to regulate the production of oxygen free radicals.

Further studies are necessary to determine whether the stimulating factor in ascitic fluid is produced by the host cells or tumor cells. This would involve further purification of the ascitic fractions and re-examination as to their effects on oxygen free radical production in mouse peritoneal macrophages.

#Second Award - Tissue Culture Association

THE WORLD OF MICROENCAPSULATION

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Microencapsulation is a unique way to package solids, liquids and gases inside plastic or wax-like coatings.

PURPOSE: To successfully master the Encapsel process and to make effective ink and scent release capsules.

PROCEDURE: The test was done by mixing methylene chloride, polystyrene and the substance being used (ink, perfume, etc.) in a glass beaker. Another solution was made by mixing a surfactant (soap) with tap water. Use equal parts tap water and methylene chloride. Pour both mixtures in a flask with a stopper and shake for 10-15 minutes. Vacuum out the methylene chloride. Heat indirectly for 10 minutes. Wash by filtering and let dry.

CONCLUSION: I successfully mastered the process for making empty microcapsules. When I attempted to encase a substance in the capsules, I had somewhat limited success. The scent release was not as strong as I had expected. The ink experiments may suggest that the capsules made were slow-release capsules.

As a result of these experiments, I plan to do further research in the field of microencapsulation.

HUMAN CHROMOSOME FRAGILE SITES AND MARKERS

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The fragile X chromosome, visualized in cell culture through exposure to an antimetabolite, FUdR (5-fluorodeoxyuridine), has become strongly associated with a form of X-linked mental retardation that is referred to as the marker X or fragile X syndrome. The present study, using both FUdR and non-FUdR cultures, has resulted in the identification of an apparently new fragile site that appears on the short arm of the X chromosome.

#Second Award - General Motors ISEF

CHANGES IN RESPIRATORY QUOTIENT DUE TO VARYING CALORIC SOURCE IN TOTAL PARENTERAL NUTRITION

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Indirect calorimetry was used to measure the respiratory quotients (RQ) of hyperalimented albino lab rats (Rattus norvegicus) receiving standard Total Parenteral Nutrition (TPN, complete intravenous nutritional needs) which varied only with respect to non-protein caloric source. High CO_2 output among human patients receiving carbohydrate calories in TPN has been attributed to lipogenesis of excess calories, however rats with induced lipogenesis (350 kcal/kg/day) had RQ's which were far above (9.1%) those of the rats actually used in the comparison (250 kcal/kg/day, about 10% below Basal Metabolic Rate). Results indicate that, even without lipogenesis, rats receiving 100% carbohydrate calories have RQ's which are significantly higher ($p<0.05$) than those infused with 100% lipid calories or a solution containing 50% carbohydrate and 50% lipid calories, averaging increases of 32.8% and 14.9%, respectively. Results also indicate that RQ's change to the new value within an hour after a rat's caloric source has been switched.

#Third Award - General Motors ISEF

#SYNERGISTIC ANTIBIOTIC COMBINATIONS PHASE III: TOXICITY DETERMINATION UTILIZING Cricetulus griseus CELL CULTURES

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The emergence of resistance in drug therapy as well as cell culture research, has become a serious problem. The ability of single antibiotics to control simple microorganisms has decreased due to their over use. The primary purposes of this project are to determine if antibiotic combinations can over come resistance and to determine the toxicity of combinations which have shown synergism "in vitro."

Cricetulus griseus (Chinese Hamster Ovary) cells, which were contaminated with a resistant Alcaligenes faecalis, were obtained. Penicillin, tetracycline, erythromycin, neomycin, lincomycin, kanamycin, gentamicin, novobiocin, streptomycin and carbenicillin were selected as possible synergistic combinations. A disk sensitivity technique and a cross-strip sensitivity test were employed in which synergism was indicated by the zones of inhibition produced. A tube dilution technique determined the MIC's of each combination. Each synergistic combination was put within the CHO-Kl cell's growing media. Toxicity was determined by observation of the cells and bacterial colony counts.

The following conclusions were made: 1) Combinations of antimicrobial agents are more effective in the control of the resistant organism than single antibiotics. 2) Tetracycline in combination with streptomycin is the only combination which synergistically controlled the test organism within cell culture without being too toxic to the cells.

#Fourth Award - General Motors ISEF

THE PRELIMINARY STUDIES OF THE EFFECTS OF THE PHORBOL ESTER AND LIPOPOLYSACCHARIDE ON IGA PRODUCTION BY MURINE MYELOMA CELLS IN VITRO.

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The MOPC 315J/P and 460 cell lines are tumor cells which secrete IgA antibody. In the presence studies, a number of chemical agents have been screened for their ability to influence IgA antibody production. To do this, cells were cultured 48 hours in the presence of the agents. The IgA levels in the cultured supernatants were measured by using an ELISA (Enzyme-Linked Immunosorbent Assay).

In this assay, microtiter plates are first coated with Goat Anti Mouse IgA. The plates are then washed and culture samples and standards are added. The plates are again washed and Biotin conjugated Goat Anti Mouse Iga was added. The plates are again washed and coated with Avidin conjugated Alkaline Phosphatase. The plates are washed a final time and an enzyme substrate is added to the wells. This enzyme substrate will produce a color change which is proportional to the amount of IgA present in the well.

Ninety-seven different samples were screened for levels of IgA production. Cultures treated with phorbol ester and lipopolysaccharide caused as much as a 2X increase in antibody production.

In conclusion, I have found that the ELISA is a rapid and reliable screening method for detection of antibody. My preliminary tests indicated that phorbol ester and lipopolysaccharide may increase IgA production in the MOPC 315J, 315P and 460 tumor cell lines.

EFFECTS OF THIRSTQUENCHERS AND EXERCISE ON BLOOD PRESSURE

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It has been established that salt in the diet has an effect upon the cardiovascular system. Liquids known as thirstquenchers are advertised to replace that which is lost during perspiration. One of the main components of these liquids is salt. To determine if these thirstquenchers have an effect on blood pressure the following procedures were conducted:

1.) Female athletes were selected and divided into 2 groups. 2.) After exercise, a mean blood pressure for each girl was determined. 3.) Group 1 was given 200ml of Gatorade and group 2 received Kool-Aid. A double blind system was used. 4.) Two techniques were used. In the first experiment the girls drank the liquid, exercised then had blood pressure taken. In the second experiment the girls exercised drank the liquid then had blood pressure taken. A mean was established for each technique.

The systolic and diastolic means were compared to the normal diastolic and systolic means. In all Gatorade blood pressure comparisons, fluctuations were found in all of the categories. This would indicate that the Gatorade was having no immediate effect. However, it was found that the Kool-Aid had a significant effect on certain aspects of blood pressure.

#THE EFFECT OF SCYLLO-INOSITOL ON PHOSPHOLIPID SYNTHESIS IN BACTERIONEMA MATRUCHOTII

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The over-all goal of this investigation is to examine the role of phospholipids in the calcification of Bacterionema matruchotii (B. matruchotii) by determining whether B. matruchotii cells retain their ability to calcify after being grown in the presence of scyllo-inositol, an inhibitor specifically of the phospholipid, phosphatidylinositol. It has been shown that membrane phospholipids play a role in complexing with calcium and phosphate initiating the mineralization process. In particular phosphatidylserine (PS) and phosphatidylinositol (PI) are of greatest importance. The experimental hypothesis of this investigation is that scyllo-inositol will decrease total lipid synthesis, synthesis of phospholipid and specifically synthesis of PI.

B. matruchotii was cultured in five batches of growth media-22 containing varying concentrations of scyllo-inositol. Cells were harvested after eight days of growth, lyopholized and weighed. Total lipid produced by cells was then extracted by a standard chloroform-methanol extraction. A phosphate assay of the lipid extract was followed by Thin Layer Chromatograph to determine the concentrations of PI and total phospholipids.

Results indicated a decrease of total lipid synthesis, synthesis of phospholipid, and synthesis of PI in experimental batches as compared to the control batch. Scyllo-inositol showed an over-all inhibition of the phospholipid synthesis in B. matruchotii.

If a way to slow or retard the synthesis of PI can be found, then the calcification of B. matruchotii might be inhibited, thereby decreasing the formation of dental calculus and dental complications.

#Third Award - General Motors ISEF

#THE EFFECT OF BEE TOXIN (APIS MELLIFERA) ON RHEUMATOID ARTHRITIS

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Rheumatoid arthritis is a disease that affects the joints of human beings. It has been treated with several pain-relieving drugs that have temporary effects. The effect of Apis mellifera toxin (venom) on rheumatoid arthritis in Ratus norvegicus was investigated in this work. The group of components that intervined were also identified. A relief and a possible cure for the disease was discovered.

Rheumatoid arthritis was provoked on Ratus norvegicus using the Freund' Adjuvant method. We subjected the toxin to the centrifugal separation technique, discovering a supernatant and a precipitate. These were injected under the skin on one ocassion at the end of the tail on a 0.1 cc/200 gr. proportion of the animal weight. By using X-rays we found that only the rats injected with the non-heated supernatant were alliviated. Thus the non-heated supernatant was the one responsible for mitigating or diminishing the degree of rheumatoid arthritis.

This supernatant is composed of simple sugars and aminoacids, thus indicating that one of these two groups or both of them are responsible for diminishing the degree of rheumatoid arthritis.

At this point in the investigation we are trying to determine if it is the aminoacids and/or the sugars the elements for the treatment of this disease.

#Second Award - General Motors ISEF

#ENHANCED IMMUNITY TO ENTERIC PATHOGENS IN BREAST-FED NEONATES: THE ROLE OF BREAST MILK CELLS

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This investigation was done to attempt to prove the hypothesis that breast-fed infants' enhanced immunity to enteric pathogens (e.g. strains of maternal E.coli)is due to an interaction between a mother's colostral mononuclear cells (sensitized to her own E.coli) and her intant's initially uncommitted mononuclear cells, such that the infant's lymphocytes' reactivity to such antigens is increased. Experiments consisted of mixed cell cultures of mothers' milk mononuclear cells and their infants' cord blood lymphocytes, with the mitogen PHA (as a positive control) non-maternal E.coli, and maternal E.coli. Controls included culturing both cell types alone with or without stimulant, and controls for mixed lymphocyte reactions. The immunological response in all cultures was measured by quantitative DNA analysis and cell counting. As hypothesized, the immune response to PHA in the mixed cell cultures was increased. Although not initially reactive to the maternal E.coli, when the cord blood lymphocytes were cultured with colostral cells reactive to this E.coli, the reactivity to this E.coli was greatly increased. Both the specifically and non-specifically increased immune responses in these mixed cultures indicates a colostral-neonatal cellular interaction to produce enhanced immunity. Although it cannot be determined exactly which cell type's response was enhanced, it is most likely that it is the cord blood cells' reaction that is increased. Thus, it can be concluded that breast milk cells are probably the major causative factor in breast-fed infants' enhanced immunity.

#First Award - American Society for Microbiology
First Award - General Motors ISEF
Second Award - United States Army

THE EFFECT OF SELECTED VITAMINS AND MINERALS ON THE REGENERATION RATE OF LUMBRICUS TERRESTIS (EARTHWORMS)

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Eighty (80) Earthworms (Lumbricus Terrestris) were used to determine if certain vitamins and minerals effect the rate of regeneration in earthworms. The eighty (80) worms were divided into eight (8) groups of ten (10). All worms had the posterior third of their body removed, and was measured to the nearest milli-meter. The worms in seven (7) of the eight (8) groups had thge wound dipped ina paste made of crushed vitamin or mineral tablets, and distilled water. The last group served as the control group, therefore, no vitamins or minerals were added. Each of the first seven (7) groups contained one (1) of the following: Vitamin A, Vitamin B, Vitamin B2, a prenatal multi-vitamin, Magnesium, Potassium, or Iron.

The worms swere measured every ten (100) days to obtain a group length, and an average worm length. In the observations it was found that Vitamin A had a total group growth of 6.2 cm, Vitamin B1 was 7.9 cm, Vitamin B2 was 4 cm, the pre-natal multi-vitamin 9.5 cm, Iron 12.7 cm, Potassium 2.6 cm, Magnesium 1.3 cm, and the control group 8.9 cm.

The prenatal multi-vitamin had the greatest effect of the vitamins tested, with the total group growth of 9.5 cm and an average worm growth of .95 cm per worm. Iron had the greatest effect of the minerals tested, with the total group growth being 12.7 cm and an average worm growth of 1.27 cm per worm. Iron had the greatest overall effect on the regeneration rate in the worms.

#THE TOXICITY OF AMINOPHYLLINE ON THE MOPOPHOLOGY OF GALLUS DOMESTICUS EMBRYOS

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Today some women with asthma or those who develop asthma during pregnancy are given the drug aminophylline to aid breathing. It has been established through studies that aminophylline may cause nausea, ventricular arrhythmia, convulsions or tachycardia. To date, there have been no studies done to determine the toxic effect this drug has on the developing fetus. With this in mind and the concern over a family problem of asthma led to the development of this project testing the toxicity of aminophylline of the Gallus domesticus embryo.

Fertilized eggs were collected and classified according to their masses and marked with identification numbers. The eggs were then placed into an incubator set at 37°C. On the 6th day of incubation the chicken embryos were innoculated in proportion to the size of the egg, either with .00cc, .5cc, .25cc or .125cc of aminophylline. The eggs were then placed back into the incubator where strict controls were maintained for all the embryos through the remainder of the experiment.

Four days prior to hatching, the embryos were examined by several linear body measurements, mass of embryos, mass of vital organs, blood smears and organ tissue thin sections. This entire process was completed three times on 50 eggs each time. The data was then collected and analyzed.

It was concluded through the analysis of the data that aminophylline was toxic to the developing embryo; it retarded the growth potential in the embryo from four to six days.

From the studies completed it can be suggested that further research can be conducted that can establish sufficient data to support the safe use of aminophylline for the treatment of asthmatic pregnant women.

#First Award - Eastman Kodak Company

THE EFFECT OF DMSO ON CRICETUS GRISETUS CHROMOSOMES

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DMSO was taken off the marbket because it was a suspected carcinogen. It's only approved use in the United States is in horses and dogs. It has never been proven that DMSO causes cancer.

A carcinogen has a high affinity with DNA which affects the chromosomal structure. Because of this the hypothesis of this project is that DMSO, a suspected carcinogen, will affect the chromosomal structure.

The problem consists of three steps. The first step was for the investigator to obtain a technique to culture chinese hamster cells. The second step was to test the cytotoxicity of DMSO on the chinese hamster cells. The third and final step was to test the effect of DMSO on chinese hamster chromosomes.

The methods are as follows; Culture the chinese hamster cells; test the cytotoxicity of DMSO on the chinese hamster cells; harvest the chromosomes which have been treated with DMSO and obtain the results.

The results showed that DMSO was toxic and increased the mitotic rate of chinese hamster cells. Thirty-four metaphases were studied from the control and no chromosomal abbervations were found. Thirty-seven metaphases were studied with DMSO, one chromosomal break was found.

It can be concluded that DMSO is toxic and increases the mitotic rate of chinese hamster cells, but it does not have a direct effect upon the chromosomes.

#ARTERIOSCLEROSIS: A STUDY OF YOUNG PORCINE AORTAS

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Arteriosclerosis is the leading cause of death in the Western world. Extensive research over the past several decades has yielded no specific cause for arteriosclerosis. However, risk factors such as high fat diet, smoking, hypertension and obesity have been established. One of the most important is excessive dietary intake of cholesterol and saturated fats. For this reason tissues from young pigs fattened for slaughter were chosen for study. Young porcine aortas were examined macroscopically for arteriosclerotic lesions. Frozen sections of these lesions were cut and some stained with Hematoxylin and Eosin for microscopic evaluation. Others were stained with Oil Red O for lipids.

Recently, Cytomegalovirus (CMV), a herpes virus, has been reported in human coronary arteries removed for bypass surgery. In this context, the presence of latent CMV in porcine arteriosclerotic lesions was hypothesized. A method for CMV detection utilizing combined Indirect Immunofluorescence and Avidin-Biotin techniques was devised.

Macroscopically, 69 of 84 aortas showed intimal lesions. All but one were located approximately 5 cm from the aortic origin, opposite the tracheal bifurcation, suggesting a shearing stress at this point.

Microscopically, 17 lesions examined showed degrees of arteriosclerosis. Oil Red O stain showed lipids in 6 lesions (35.29%). Indirect immunofluorescence showed 4 lesions positive for CMV (23.53%) and another two showed questionable positivity.

CMV in porcine arteriosc lerotic lesions has not been reported in literature to date.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

IMPEDANCE OF FLUID FLOW IN A CIRCULATORY MODEL

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Obstructions and vessel curvature both contribute to impedance of blood flow within the arterial system. My research investigated such impedances and can be related to impedances found in coronary diseases such as arteriosclerosis.

Tygon and latex tubing was used to build a model of the arterial system. With this model I created obstructions; cross-sectional area reductions and curvature. A solution of water and glycerine was used to simulate the viscosity and flow characteristics of blood, thus enabling me to measure volume flow and pressure variation that would occur as a result of obstructions within the arterial system. Using this apparatus, I observed a steady laminar flow state and a pulsatile flow state. I observed that the laminar flow became turbulent in regions of obstruction. To simulate the pulsatile action of the heart, a syphoning pump was used to create an oscillatory motion.

Qualitative and quantitative observations were made during my experimentations. Resin beads, placed in the fluid as tracers, enabled me to observe the increased turbulences that occured at all obstructions. I could quantitatively measure pressure and flow volume variation that occured due to the obstructions; volume flow reduction was found distal and increased pressure found proximal to the obstruction. I also found that flow volume reduction was directly proportional to the quantity and size of the curves.

A better understanding of impedances and their effects within the arterial system was the result of my experimentations. My research also provides valuable insight into the behavior of blood within the system and is relevent to the current direction of arterial research.

#AN INVESTIGATION OF THE EFFECT OF MACROPHAGES ON DNA SYNTHESIS BY EMT6 TUMOR CELLS

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The purpose of this investigation is to determine if tumor-cell reproduction is directly affected by the presence of macrophage cells specifically activated for killing tumor cells.

In order to carry out this investigation, macrophages (large cells that destroy harmful cells) and tumor cells were obtained from mice and were incubated in culture plates. These cells were organized into three separate groups: 1) ENT6 tumor cells alone, 2) EMT6 tumor cells with activated macrophages (activated for killing tumor cells) and 3) EMT6 tumor cells plus unactivated macrophages.

Each group was allowed to grow in vitro (in culture plates) over a total period of 24 hours. During this time, samples from each group were fixed (preserved) at time intervals of 0 hours, 8 hours, 14 hours, and 24 hours. All of these samples were analyzed to observe what effect the macrophage cells had upon DNA production by the tumor cells. If more DNA was being made, more tumor cells would be dividing.

The macrophages that had been activated for killing tumor cells did indeed significantly reduce DNA production. Unactivated macrophages did not exert this same effect.

In conclusion, this investigation supports the idea that activated macrophages decrease DNA production in tumor cells. This could prevent or reduce tumor-cell division. In general, the results of this investigation could be useful in learning how to control the spread of cancer.

#First Award - American Medical Association
Fourth Award - General Motors ISEF

Discovery and Characterization of a Low Dalton Cardiotonic Factor in *Auricularia polytricha*

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Black Tree Fungus (*Auricularia polytricha*) is used by the people of Hawaii in many of their cultural food dishes. Previous observations made on crude non-fractionated Black Tree Fungus suggest the presence of a factor with a potentially beneficial physiological property. This factor possesses a cardiotonic property (the exertion of a favorable action on the heart-inotropic effect). This study presents data that suggest the presence of a cardiotonic factor and attempts to characterize this compound in Black Tree Fungus.

The procedures used were column chromotography, dialysis, freeze-drying, thin layer paper chromotography, and an atria sutdy using a guinea pig heart attached to a polygraph.

The extract was dialyzed and the dialysate was tested and there was a positive cardiotonic effect. This suggests that the active constituents of this cardiotonic factor is indeed a low molecular weight compound. The concentrated dialysate was then separated by thin layer paper chromotography. Two bands from this separation showed cardiotonic activity. This suggests that in the future, the active cardiotonic factor can be further characterized by examination of these two bands.

Black Tree Fungus has been found to have a cardiotonic factor which consists of low molecular weight compound(s). Further studies are presently being done to characterize, isolate, and elucidate the structure of this cardiotonic factor found in Black Tree Fungus through thin layer chromotography, HPLC, and NMR. Whether these low molecular weight compound(s) will have significant value in treatment of cardiac patients remains to be determined.

#Second Award - General Motors ISEF

TO DEVELOP MIXED SPHEROIDS FOR USE AS A POSSIBLE TUMOR MODEL

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A tumor model is a model which tests the effectiveness of chemicals and/or radiation on the control of tumor formation. An ideal model would be one which mimicks in vivo body conditions. Mixed spheroids, which are agglomerates of cells growing suspended in nutrient medium, may be such a model. Spheroids are more relevant to in vivo conditions yet they have the accuracy of in vitro methodology. A practical application of spheroids is that cells from a person's biopsy may be incorporated into the spheroid and tests may be performed to determine an individual treatment for the patient. Several approaches towards the development of mixed spheroids were taken. Radiation and growth curve studies were performed. It was observed that mixed spheroids which contained the thymindine analog bromodeoxyuridine (BUDR) and were exposed for long peroids of time to light were inhibited from forming colonies, possibly because of the death of cells due to light.

#Fourth Award - General Motors ISEF

EFFECT OF MAIN AND SIDE STREAM SMOKE

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The purpose of this experiment is to see if second-hand cigarette smoke is harmful to the non-smoker and also if sidestream smoke (the smoke that drifts off the end of the cigarette) is more harmful than mainstream smoke (smoke that is inhaled by the smoker, partially filtered by his or her lungs, then blown back out into the room).

For 22 days the time required to complete the maze without exposure to smoke was recorded, the average time was 26 seconds. After exposing two of the rats to one minute of sidestream smoke the average time required to complete the maze rose to 92 seconds. When subjected to three minutes of sidestream smoke the average time rose to 169 seconds. After exposing the other two rats to one minute of mainstream smoke the average time increased to 73 seconds. After three minutes of mainstream smoke the average time increased to 147 seconds. All factors except the smoke remained the same.

Because of the great increase in the average time required to complete the maze after exposure to smoke (26 seconds compared to 73, 92, 147, and 169 seconds), it appears that breathing in another person's cigarette smoke is harmful to your health.

Sidestream smoke also has a greater effect on the non-smoker than does mainstream smoke: 92 seconds as compared to 73 seconds and 169 seconds compared to 147 seconds.

THE RELATION OF FOOD ALLERGIES TO HYPERACTIVITY AND THE TENSION-FATIGUE SYNDROME IN CHILDREN

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Fifteen million children today are affected with hyperactivity and a significant number exists with tension-fatigue syndrome (TFS). These children are accused of being unintelligent and may be academically and socially disabled.

It was the researcher's belief that food allergies were related to TFS and hyperactivity. She devised a study to proove the same. By restricting the diet to exclude the offending foods, it was possible that intellectual, emotional and social behavior would improve.

The two experiments conducted were:

(1) Twenty subjects suspected of hyperactivity or TFS were tested for allergies by the scratch test on the back and examination of a nasal smear. If the child was allergic to any food, the researcher requested the parents to remove the suspected food from the diet for two weeks. After the prescribed period, the food was reintroduced to see if it really provoked the original symptoms.

(2) A questionnaire was given to a randomly selected population of one hundred and fifteen children to determine those affected by hyperactivity, TFS and food allergies.

The researcher found that twenty-five percent of the boys and seventeen percent of the girls were hyperactive. It was found that seventy-seven percent had food allergies and forty-three percent said that certain foods changed their behavior.

In the control diet group seventy percent improved remakably. Twenty percent showed a partial improvement and only ten percent showed no improvement. The researcher concluded that food allergy played a significant role in hyperactivity and TFS and meritted further research.

#A COMPARISON OF THE EFFECTS OF SELENIUM ON THE MULTIPLICATION AND VIABILITY OF NORMAL AND B77 VIRUS-TRANSFORMED RAT FIBROBLASTS AND ON NORMAL AND SPONTANEOUSLY-TRANSFORMED HUMAN FIBROBLASTS

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Selenium has been shown to be both a carcinogen and a cancer inhibitor depending on dosage. Questions about effects of selenium on DNA are unanswered. No research had been done on B77 virus-transformed rat fibroblasts involving selenium. The hypothesis was that selenium at low dosage would accelerate cancerous cell growth but that doses less than the lethal level would inhibit growth. Subculturing techniques were learned and a preliminary test to determine upper and lower levels of sodium selenite was made. Using the smallest lethal concentration as the upper level, concentrations of 1.56 to 100 micromoles of sodium selenite were prepared, and used on triplicate cultures of each of the four types of cells. After incubation periods ranginf from 48-72 hours, two each of the cultures at each concentration were counted and a third was used for trypan-blue viability testing. Results were tabulated and the study was repeated for confirmation. Results showed that indeed, sodium selenite at low concentrations accelerates cancer growth, but that less than lethal levels inhibits growth. Human cells were found most affected by the selenium and growth did not resume when the selenium was removed and fresh medium was replaced. Further studies into the reason for the failure of the cells to resume growth is planned. Selenium does have a differential killing effect.

#Fourth Award - General Motors ISEF

THE EFFECTS OF RETINOL ON THE UNBORN RAT FETUS

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What are the effects of Retinol on the unborn rat fetus? My project deal with two aspects of hypervitaminosis A. The first aspect dealt with dosage levels. I attempted to find the most varied malformations. In the second area I wanted to observe the variety of malformations caused by hypervitaminosis A. I treated pregnant rats with Retinol on days 9 and 10 of gestation to see the malformations that would be produced. I dosed at three different dose levels: 60mg/kg,90 mg/kg and 105mg/kg, I sacrificed the pregnant rats on day 20 of a 21 day gestation. The reason for this is to keep the mother from cannibalizing the abnormal pups before they can be observed. The fetuses in the two lower dose groups showed many malformations such as exencephaly, encephalocele, microtail, spina bifida, micropthalmia, malpositioned hindlimbs and cleft palate. These fetuses were examined under a microscope and fresh tissue dissections were performed on one fetus from each litter to check for obvious internal malformations. None were found. In the highest dose group there were no surviving fetuses. The vitamin A seems to have incapacitated the growing process and kept it from replacing or repairing the cell in the head region, where most malformations occurred.

THE EFFECT OF ANTHELMINTIC AGENTS ON SHEEP PARASITES

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The purpose of the project was threefold; first, to use fecal cultures in the diagnosis of parasitism in sheep; secondly, to identify and estimate population of tertiary or infective larval stage infesting sheep; and finally, to determine which of three commercial dewormers-Benzelmin, Tramisol Injectable, or Ivomec-was most effective.

The primary factors of importance in the procedure were four fold: First, the collection of twenty-five independent sheep dung samples were procured. The samples were placed in cheesecloth bags and suspended in a jar for a incubation period of seven days. After incubation, the samples were baermannized for two hours for subsequent collection of the tertiary filariform larvae. Finally, the miscroscopically identifiable larvae were collected and subjected to the commercial anthelmintic preparations. Research was performed to obtain the lethal and threshold dosage concentrations effecting the larvae in-vitro.

In conclusion, the evaluations of the athelmintic agents were performed in four areas. The areas were parasite killfactor, ease of administration, safety of use, and cost per dose.

When the four factors were considered, the dewormers were ranked in the order of Ivomec, Tramisal Injectable, and Benzelmin respectively.

#THE EFFECTS OF PRENATAL ADMINISTRATION OF FUROSEMIDE ON GROWTH AND SURVIVAL RATES OF RATTUS NORVEGICUS

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The purpose of this study was to determine if prenatal administration of Furosemide would cause differences in pup growth and/or survival rates. This project is Phase III of a study conducted by this researcher in which the administration of Furosemide to pregnant rats resulted in fetal weight differences, control versus experimental, significant at ($p < 0.001$), placental weight differences significant at ($p < 0.001$) and incidence of placental congestion significant at ($p < 0.005$). Twelve nulliparous female rats were divided into control and experimental groups of six. They were bred when estrus was demonstrated by vaginal smears and were alternately placed in one of the groups when pregnancy was verified by the presence of a vaginal plug. Injections based on body weight were given from day four of gestation to delivery with experimentals receiving Furosemide and controls receiving saline. The controls were pair fed to assure that differences observed were not due to nutritional factors. Blood samples were taken at completion of the study for bacteriologic and serologic examination. The Student's t Test was performed on the following weights: Pup birth weight highly significant ($p < 0.001$); Pup weight gain significant ($p < 0.05$); Pup weight at weaning significant ($p < 0.05$). The Chi-square test performed on pup survival rate was significant ($p < 0.005$). It appears that the administration of Furosemide does cause differences in growth and survival rates of the pups.

#First Award - American Veterinary Medical Association
First Award - General Motors ISEF

#PHYSIOLOGICAL, HISTOLOGICAL AND CHEMICAL STUDY OF THE EFFECT CAUSED BY THE COTTON SEEDS EXTRACTS BY THE GENUS GOSSYPIUM AS A INOFFENSIVE AND REALIBLE MALE CONTRACEPTIVE.

RIVERA, SANTIAGO., DR_ PILA HIGH SCHOOL.,PONCE,P.R. 00731
BALDORIOTY STREET #15, PONCE,P.R. 00731

The principal purpose is to determine the histopathological and toxicological effects observed from various specific extracts obtained from the cotton seeds of the genus Gossypium used as an inoffensive and realible male contraceptive in male mice of the species (Mus-Muscule)of the bread CD-1.The first part consisted of a direct study of the cotton seeds.Test were carried out to determine the pigmentation,water,organic material and minerals.The second part is a toxicological and histological tests as to the sensibilities of various male mice organs during the usage of different cotton seed extracts.The third phase is the physiological study of the effect of the cotton seed extract in the different male mice organs. The four part consisted of the separation and identification by means of a chemical analysis of the components of the cotton seed extracts with causes the masculine contraceptive effect.The first part of our research we have found that the southwestern part of the island in the best cotton productive area.There we have found three different cotton plants known as:Gossypium barbadense ; Gossypium barbadense var. maritima, watt, and Gossypium hirsutum.The only pigment found is the Chlorophyll A and the percentage of the seed water is 13.3%;5%minerals and 81.6%0. material.The second part of our toxicological research revealed that yhe extract were not toxic when used in doses menor .5cc.The histological study revealed that the cotton seed extract do not make any harm to the cellular tissues of the liver,kidney,lungs and testicles.The sensibilities test of the male mice testicle attested that the cotton seeds extracts entirely avoid the production of spermatozzons.Amazedly,the study also showed that once the cotton seed extracts are not applied,the production of spermatozzons becomes normal.The physiological study revealed a menor level of Bilirubin,which apparently due to low level of Hemoglobin,the C.P.K. test showed a normal concentration just the same as to that Urea Nitrogen if compared with the pilot mice.The four phase revealed that the chemical analysis that the one of the composities of the cotton seed extracts with cause the masciline contraceptive effect is"Gossypol". The cotton seed extracts have a inoffensive and realible male contraceptive.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Third Award - General Motors ISEF

THE EFFECT OF VARIOUS AMOUNTS OF CAFFEINE ON THE EMBRYO DEVELOPMENT AND BEHAVIOR OF MUS MUSCULUS, Stephanie Cottrell, South Sumter H.S., Bushnell, FL 33513; Route 2 Box 510, Lake Panasoffkee, FL 33538

The purpose of this experiment is to see what effect caffeine has on the embryo development and behavior of Mus musculus.

The mice were divided into four groups each having two females and two males. Group A, the Control Group received no caffeine. Groups B, C, and D the experimental groups orally received caffeine mixed with food daily. Group B, the Experimental Group, received 100 milligrams of caffeine. Group C received 200 milligrams of caffeine. Group D received 300 milligrams of caffeine. All groups had their metabolism tested before, during, and after the experiments.

The young of both the experimental and control groups were weighed at the ages of one week, two weeks, three weeks, and four weeks old. When the young were four weeks old they were timed running a maze and their metabolism was tested.

Caffeine is a stimulant, which speeds up the heart and respiratory system. Due to the effect of the caffeine the experimental young weighed less than the control young. The experimental young also ran the maze faster than the control young. Caffeine has a calorie burning effect, due to this effect the metabolism of the experimental young was slightly higher than that of the control young.

THE RELATIVE EFFECTIVENESS OF STAIN REMOVING TOOTHPASTES

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PURPOSE and HYPOTHESIS: The purpose of this project was to determine if the toothpastes most people use everyday would be as effective as "smoker's toothpastes" (for example, Topol and Zact) in removing tobacco stains from human teeth. My hypothesis was that regular toothpastes would be as effective or better in the removal of tobacco stain than "smoker's toothpastes". Also, I wanted to determine from available information if there would be any harmful side effects in doing this cleaning.

PROCEDURE: Human teeth were pre-whitened, stained two different ways, pre-examined for degree of stain, and brushed with a brushing machine specially designed for applying the same pressure on each tooth. Finally, teeth were examined for cleanliness.

CONCLUSIONS: After thorough examination of the teeth used in my experiment, I ranked them in order based on the amount of stain removal. Generally, the tests did not show a superior cleaning ability in "smoker's toothpastes" while available information shows these toothpastes to be highly abrasive and potentially damaging to teeth.

#ALZHEIMER'S DISEASE, LOU GEHRIG'S DISEASE AND ELEPHANT MAN'S DISEASE: BIOACTIVE PEPTIDE, NUCLEIC ACID ANALOG AND G-FORCE ATTEMPTS TO RESTORE GROWTH IN SENILE DEMENTIA: PHASE III.

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Alzheimer's, Lou Gehrig's (Amyotrophic Lateral Sclerosis; ALS), and Elephant Man's (Neurofibromatosis; NF) Diseases are anomalies not bound by racial or ethnic limits. Neither cause, cure nor means of control are known. Abnormal neurite lines have degenerate axons and filapodia.

Research in phases I and II indicated that the nucleic acid analogue 8-Azaguanine (8-AZ) and the growth factor analogue 2.5S Nerve Growth Factor increases axon length and filapodial growth in ALS and NF cells.

The objectives of this research were to determine the effects of TRH (Thyrotropin Releasing Hormone), 8-AZ, and centripetal force on axonal length and filapodial density of fibroblastic Alzheimer's neurites. G-Force has been inspired as a spinoff by the author's related experiment that will fly in microgravity on a NASA shuttle mission in early 1986!

Human fibroblastic neurite cell lines were cultured in Dulbecco's Modified Eagle Medium in a Sykes-Moore chamber and a large homebuilt chamber. Nikon micrometric optics and projection screen were used to measure axon length. Density standards determined filapodial growth.

The data was expressed as axon mean length and subjected to a t-test of significance. Filapodial growth was expressed as the percentage of neurites lacking microspikes that developed them and the percentage that had filapodia increase two density levels: sparse to very dense.

Both TRH and 8-AZ significantly increased Alzheimer's neurites' axon length and filapodial growth, while G-Forces had no effect. Neither agent was deleterious to normal human neurites. 8-AZ results suggest that diseased neurites may lack enough guanine necessary for mediating metabolism and instigating growth. TRH may act with cyclic AMP on target neurites containing specific receptor proteins that bind TRH.

#First Award - General Motors ISEF
First Award - National Aeronautics and Space Administration
First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

#THE UTILIZATION OF SMALL ANIMAL-TO-PATIENT BONDING IN THE THERAPEUTIC TREATMENT OF THE PROFOUNDLY DEVELOPMENTALLY DISABLED PATIENT

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An experimental program was designed using ten selected patients in a developmentally disabled residence facility in order to determine the effects of an animal-to-patient bonding on stimulating actual physiological and neurological patient improvement in the following areas: large motor skills, small motor skills, verbal skills and patient responsiveness, body coordination, and task achievement. A twenty-week series of activity periods was devised with the patient-resident utilizing an extrinsic non-intimidating medium of a small animal. Patient goals were established in terms of task assignments relating directly to the specific animal used during that period. This format was developed to counteract pronounced communication barriers and patient fear associated with institutionalized profoundly handicapped individuals which limits traditional therapies. Additional objectives included providing a minimum-cost program format, the utilization of relatively unskilled manpower, and the establishment of an enrichment methodology for patient personal growth. Case study data showed patient improvement in ten out of ten patients in at least one above parameter tested. Results suggest potential as a tool in the rehabilitation process with minimum cost, minimally trained manpower, and even on a limited scale as two to four hours per week. As the format progresses the importance of the animal may be decreased as the researcher (therapist) forms a trust relationship and a bond between the patient and himself.

#First Award - American Veterinary Medical Association
First Award - Eastman Kodak Company
First Award - United States Navy/Naval Medical Research and Development Command
Third Award - American Psychological Association
Third Award - General Motors ISEF

ROADSIDE PASTURES ARE THEY SAFE?

MARTI, JOHN E.- CRESCENT CITY HIGH SCHOOL
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The purpose of this project is to prove whether or not the pastures located on the sides of our major highways or outher roads are safe for grazing livestock.

It is my belief that the exhaust coming from todays automobiles can possibly br emitting enough lead to cause lead poisoning in the cattle that graze on roadside pastures.

After running tests on pasture grass samples I have reached the conclusion that there is lead content in our pastures and that there is enough lead in some places to cause possible lead poisoning in our cattle.

After concluding this project I have formed the opinion that if cattle are allowed to graze on this contaminated land it can and will cause harm to the animal.

#First Award - American Medical Association

#EPIDEMIOLOGY OF STREPTOCOCCAL PHARYNGITIS

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Purpose: To determine and analyze the incidence of Streptococcal Pharyngitis in a given population [Millard Co., Utah]

Procedure: Date of research: Dec 3, 1984 - Mar 14, 1985. Three medical doctors with general practices took 539 throat swabs of patients with medically attended sore throats. Pertinent data were collected on each patient. Throat swabs were collected daily from the clinic and plated on blood agar with group A differentiation discs. Plates were incubated 24 hrs and read for beta-hemolysis, A grouping.

Results: 4,679 patients were attended, 539 throat cultures were plated, 257 were treated with antibiotic, 119 were positive group A streptococci.

Conclusions: Data indicate significant evidence of acquired immunity against re-infection. Many non-pos. strep sore throats are treated with antibiotics. Age related icidence was highest in the 5 yr to 9 yr age grp.

Application: Practicing physicians should consider using a method of strep detection before treating patients with pharyngitis to eliminate unnecessary antibiotic therapy.

#Second Award - United States Air Force

TOPICAL SENSITIVITY TESTING OF MEDICINAL CREAMS AND PURIFIED ALOE ON BACTERIA GROWTH: PHASE THREE

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This comparison and study represents and attempt to study the possible inhibitory effects of Aloe barbadensis over six species of gram-possitive and gram-negative bacterias. This project was continued to give support to the hypothesis arrived at by an earlier project -- Aloe barbadensis has a healing property, but is not useful as an antibiotic. The effects of different concetrations of Aloe barbadensis on the growth of Streptococcus pyogenes, Escherichia coli, Staphylococcus aureus, Candida albicans, Klebsiella, and Psuedomonas aeruginosa, and bacteria (Staphylococcus) from two Eschar burn tissue biopsies were studied and compared to various medicinal burn creams. Bacteria was cultured under normal laboratory conditions using standard methods. All bacterias were cultured in nutrient agar and BHIA for this test. Sensitivity tests were conducted using the Kirby-Bauer Method. The antibacterial effect was determined by the diameter of the inhibition zone in centimeters. Extracts were applied by the use of agent wells in concentrations of x5, x10, using fresh and month-old aloe, 1:1 dilutions and neat aloe. Plates were incubated at 37° C. The aloe proved to have no inhibitory effect under these conditions on these bacterias.

SALAD BOWL MICROORGANISMS

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PROBLEM: What kind of microorganisms develop on raw vegetables in a salad bar located in a restaurant and are harmful to the human body?

HYPOTHESIS: Some bacteria growing on foods found in salad bars may be pathogenic.

METHODS: Five vegetables from each of four restaurants were cultured on Rodak agar plates. Colony growth was isolated on blood agar plates. Standard Gram-staining techniques were used to analyze the characteristics of the bacteria colonies. Special API-20E tests were then run to determine the metabolic characteristics of the bacteria. After identifying the microorganisms, their possible affect on the human body was determined.

RESULTS: (a) A large amount of colony growth from each vegetable was obtained.
(b) The Gram-stained slides determined that the majority of the microorganisms were Gram-negative rods.
(c) The API tests helped identify most of the bacteria.
(d) The genus, Pseudomonas, was found to be most abundant.
(e) Most of the identified microorganisms were found to be linked to contaminants of the vegetables before being placed in a salad bar.

CONCLUSION: Some pathogenic microorganisms can be found in salad bars.

THE EFFECTS OF ETHYLENE OXIDE STERILIZATION ON BONE INDUCTION AND MICROBIAL CONTROL IN DEMINERALIZED BONE ALLOGRAFTS

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The purpose of phase I of this study was to determine the effects of ethylene oxide (EO) sterilization on bone induction by demineralized bone allograft. Long bones were processed into demineralized bone material (DBM), and a portion of the material was sterilized with EO. The material was implanted in rats, the graft sites were harvested, the specimens examined, treated, and submitted for histological processing.

The EO treated nodules had less cartilage than the control nodules at both 2 and 7 days. At 7 days the EO treated nodules were hemorrhagic cysts and contained red blood cells. Also, inflammatory cells were present. Similar results occurred in the specimens harvested at 21 and 42 days. It appears that EO sterilization has a negative effect on bone induction. This can be seen by the gross and histological findings of hemorrhagic cyst formation and the presence of inflammatory cells at 7 days. A possible mechanism for these findings may be damage to the local tissues including blood vessel walls caused by the toxicity of EO and its reaction by-products.

The purpose of phase II is to reduce the toxicity of EO to bone cells while retaining an antimicrobial effect. Preliminary research showed that EO sterilizes a medium including eliminating the spores when exposed for 12 hours. In a growth curve experiment, EO inhibited growth of Bacillus subtilis for approximately 180 minutes after sterilization.

The EO sterilized DBM was treated with a saline solution which reduced EO and reaction by-product residues. Bacillus subtilis was used as a model to determine the growth curve. Gas chromatography is now being used to measure EO and reaction by-product residues in saline treated bone.

#Fourth Award - General Motors ISEF

AMMONIUM CHLORIDE'S EFFECT ON HERPES SIMPLEX AND MOUSE MENGO VIRUSES

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Certain animal viruses are able to enter cells through endocytosis, ending up in acidic vesicles such as lysosomes where they were believed to be destroyed. However, recent research has suggested that some enveloped viruses are able to infect cells through endocytosis. It was found that chemicals which elevate the pH of the lysosome inhibit an early stage of viral infection but not viral absorption or penetration. It is believed that the acidity of the lysosome triggers a fusion reaction between the lipid membranes of the lysosome and the virus envelope, resulting in the release of the viral nucleic acid into the cytoplasm. This research tests the effect of the lysosome inhibitor ammonium chloride on the enveloped herpes simplex virus I (HSV) and the naked capsid Mouse Mengo virus (is+). Concentrations of about 500 µg/mL of ammonium chloride were not cytotoxic to vero and G-3 cells, the two cell lines used with HSV and is+. Ammonium chloride was found to have no effect on is+ infection. Because preliminary plaque assays indicated that ammonium chloride inhibited a stage of HSV infection after absorption, a one-step growth experiment was conducted to determine more precisely what stage of infection was affected by the lysosome inhibitor. The results indicated that 500 µg/mL of ammonium chloride affected an early stage of HSV maturation. It was concluded that neither HSV nor is+ normally infect host cells through endocytosis. However, ammonium chloride was found to inhibit a later stage of HSV infection.

#STUDIES ON GROWTH HORMONE: III. IDENTIFICATION OF RECEPTORS FOR GROWTH HORMONE AND PROLACTIN USING CROSS-LINKING TECHNIQUES

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Evidence suggests that the growth hormone (GH) receptor has acquired new functions through evolution. Because of the additional functions, it might be expected that the receptor in mammals differs structurally from that in lower class vertebrates. Phases I and II used tissue culture techniques and monoclonal antibody techniques to study the effects of growth hormone in cellular systems. In Phase III, extremely sensitive cross-linking techniques were used to determine if there were structural changes among growth hormone and prolactin receptors from various species of vertebrates. The cross-linking reagent covalently bound the receptor to radioactively labeled GH. This labeled GH/receptor complex was analyzed by sodium dodecyl sulfate (SDS) gel electrophoresis followed by autoradiography. Rabbit liver showed specific binding of labeled human GH to a GH receptor while the mouse liver showed specific binding of labeled human GH to a prolactin (PRL) receptor. Electrophoresis and autoradiography demonstrated that the molecular weight of the rabbit liver GH receptor was approximately 53,000 daltons, whereas the molecular weight of the mouse liver PRL receptor was approximately 43,000 daltons. No receptors were identified in liver from the frog or lizard, suggesting that liver from these species may not contain GH receptors or that the receptors in amphibians and reptiles do not recognize mammalian hormone.

#First Award - American Medical Association

#VARIATIONS IN THE PHENOTYPIC EXPRESSION OF ANTIMYCOTIC PRODUCTION IN P. SYRINGAE MUTANTS DERIVED FROM E. COLI TRANSPOSITION

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Pseudomonas syringae is a plant associated bacteria, which possibly can be used for plant disease control. P. syringae produces an antimycotic which inhibits the fungus Ceratocystis ulmi, which causes Dutch elm disease and Geotrichum candidum, the fungus used in this experiment.

Applying a genetic approach to experimentation with P. syringae has proven to be very beneficial. Genetic material can be passed from one bacterium to another through the process of conjugation. Genes carried in this transposon can cause variations in the antimycotic production by P. syringae. The purpose of this project is to try to develop a P. syringae mutant that produces a more effective antimycotic.

In order to obtain P. syringae mutants, a 1:1 mixture of P. syringae and Escherichia coli strain HB101 were mixed. A dilution of the mixture was plated onto Dyes medium. Since E. coli is auxotrophic to certain amino acids, it will not grow on this medium. The only bacteria surviving will be P. syringae and its mutants. These colonies were replica printed onto Pseudomonas agar F with kanamycin. Since P. syringae is kanamycin sensitive and E. coli is kanamycin resistant, the only bacteria present will be P. syringae which have received the E. coli transposon carrying kanamycin resistance.

These mutants were tested with Geotrichum candidum to determine their antimycotic production. It was found that the variations in the antimycotic production ranged from no production to the production of a more effective antimycotic. It has been found that a P. syringae mutant can halt the spread of fungus in trees after inoculation.

#Fourth Award - American Phytopathological Society
Fourth Award - General Motors ISEF

THE MAINTENANCE OF PLASMIDS IN BACILLUS SUBTILIS

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The purpose of this experiment was to determine the effects of three variables on the maintenance of a plasmid in Bacillus subtilis. Plasmid pE194 (an R factor conferring erythromycin resistance) was studied in four B. subtilis BR151 strains. Two strains were sporulation negative mutants; one strain contained a copy number mutant form of the plasmid having a doubled copy number. Through a specialized use of the replica plating technique these hypotheses were tested: Sporulation and the absence of selective environmental pressure will cause increased plasmid instability, and the higher copy number plasmid will be maintained longer than the wild-type form. All procedures were conducted on limited nutrient media to induce sporulation and amplify instability. It was found that sporulation contibuted to instability of the plasmid. Constant selective pressure also increased instability in the absence of sufficient nutrients. The high copy number plasmid was maintained slightly longer than the low copy number form. Therefore, industries using B. subtilis plasmids should cultivate strains on high nutrient media to discourage sporulation and increase plasmid stability.

#Third Award - General Motors ISEF

#DETECTION OF NON-PIGMENTED STRAINS
OF CHROMOBACTERIUM VIOLACEUM

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Chromobacteriosis is a usually fatal systemic disease of humans and animals. It is caused by Chromobacterium violaceum, a bacterium found in tropical soils and water, recognized by the purple pigment violacein. Of the 15-20 cases of Chromobacteriosis, 9 have been documented in Central Florida. This disease has been recognized only by the pigment character, however, it is possible that many non-pigmented variants have not lost the disease ability. In a bile media C. violaceum is blue and diffuses into the agar. When a suspected non-pigmented strain grows in the vicinity of the blue diffused compound a violet precipitate occurs. When Kaolin clay was added a second (and blue) band between the pigmented and non-pigmented strains appeared. The data suggests that the non-pigmented organism excretes a compound(s) which react with a diffusible excretion from the pigmented strain and violacein results. Therefore, it is hypothesized that non-pigmented strains may be detected in the bile-clay medium when pigmented and non-pigmented organisms are co-cultured. A preliminary test showed that approximately 100 non-pigmented strains per gram of pond soil were detected. Eventually clinical isolates could be similarly tested to determine a more realistic number of Chromobacteriosis cases.

#Third Award - General Motors ISEF

#BIOLOGICAL STUDIES OF NITROGEN FIXING & ANTIBIOTIC PRODUCING MICROORGANISMS ON LEGUME AND NON-LEGUME PLANTS PHASE III

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Agriculture is the number one industry in the United States and North Dakota. To increase crop production many inorganic substances such as N_2 fertilizers and fungicides are used.

Results of research experiments conducted in four previous years have indicated that N_2 fixing bacteria will provide significant amounts of nitrogen to alfalfa, wheat, and corn, thus leading to good possibilities of these bacteria being used as biological economical substitutes for N_2 fertilizers.

The objective of Phase III determines which combination of variables (fallow vs. continuous cropping and herbicide vs. no herbicide) would show the greatest statistical significant increases in plant growth, grain yields, and protein content on the N_2 fertilizer, N_2 fixing bacteria (Azotobacter & Azotospirillum), and negative control treatments thus indicating which conditions are most effective in increasing crop production. The results of a field test plot indicated the most significant increased grain yields and protein content in the combination N_2 fixing bacteria-fallow treatment. There was no significant difference between herbicide application.

Enhanced plant growth may increase diseases and the growth of N_2 fixing bacteria may be inhibited by the use of inorganic fungicides to control disease. Conclusive evidence in Phase II-Part 2 indicated that the biological antagonist Pseudomonas cepacia will successfully inhibit the growth of the major leaf spotting fungus Septoria nodorum when inoculated on the same day.

In Phase III-Part 2 inoculation studies determined the resistance and susceptibility of selected spring wheat cultivars to S.nodorum with various inoculated P.cepacia concentrations. Results indicated that P.cepacia concentrations of 10^3, 10^4, 10^5, 10^6 and 10^7 cells/ml of distilled H_2O would significantly inhibit S.nodorum growth enabling the possibility of P.cepacia being used as a biological substitute for inorganic fungicides on spring wheat varieties.

#Second Award - American Phytopathological Society
Second Award - American Society for Microbiology
Fourth Award - General Motors ISEF

THE EFFECTS OF MONOCLONAL ANTI-IgE RECEPTOR ANTIBODIES ON HISTAMINE RELEASE OF RAT BASOPHILIC LEUKEMIA CELLS

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This project explored a possible means of inhibiting allergic responses by determining if the IgE receptor of rat basophilic cells could be be blocked with monoclonal antibodies specific for these receptors. The hypothesis: if IgE binding is inhibited, indirect IgE mediated secretion of histamine from these cells would be greatly decreased.

Three monoclonal IgG antibody samples were obtained from mouse ascites. These monoclonal antibodies were thought to be anti-IgE receptor of rat basophilic leukemia cells. Each was purified by the process of 50% ammonium sulfate cut, and ion exchange chromatography. Once purified, it was determined that these monoclonal IgG were indeed anti-IgE receptor, and would inhibit 99% to 100% of IgE from binding at concentrations greater than 10 micrograms per ml.

Each monoclonal antibody caused release of histamine directly, though only minimally at higher concentrations. The IgE receptor was then blocked with varying concentrations of the monoclonal IgG, and the cells were then stimulated to release histamine indirectly with IgE. Controls released 40% of the total histamine content while the blocked experimentals only released between 0-3% of the contained histamine.

These monoclonal anti-IgE receptor IgG antibodies did inhibit IgE mediated histamine release. This could have important applications in medicine, by providing a potential means of decreasing allergic responses in man, caused by IgE mediated histamine release.

#First Award - General Motors ISEF

THE EFFECT OF CAFFEINE ON HUMAN NEUTROPHIL PHAGOCYTOSIS

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This study deals with the effect of caffeine and an analog, theophylline, on the phagocytic process using human neutrophils. Opsonized yeast cells (Candida albicans) were the objects of phagocytosis in a phagocytic assay. Yeast cells were opsonized with human complement in a 1:10 serum: saline mixture. Neutrophils were obtained from human blood using 3% dextran solution, differential centrifugation, and density gradient centrifugation. The resulting preparation of neutrophils and a yeast cell preparation were each counted in a hemocytometer to determine cell concentration. The phagocytic assay was conducted utilizing a preparation with a ratio of 1 neutrophil to 4 yeast cells. Five and ten minute pre-incubation of neutrophils with caffeine/ theophylline or saline control occurred before the addition of yeast. The resulting mixture was incubated for thirty minutes at 37 degrees C. The extent of phagocytosis was determined microscopically and expressed as a percentage of the number of neutrophils with ingested yeast versus total neutrophils counted. Both theophylline and caffeine (10^{-3}M) significantly enhanced phagocytosis over controls ($P<.05$) with either 5 or 10 minute pre-incubations. Lower concentrations of caffeine had no effect while 10^{-2}M was inhibitory.

TOXIC SHOCK SYNDROME

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Since 1976, the reported incidence of Toxic Shock Syndrome has risen dramatically and tampons are believed to play a major role in this increase. The purpose of this experiment was to study the role tampons play in Toxic Shock Syndrome by determining the effect of tampon leachables on the competitive survival of S. aureus in mixed cultures. This could have practical applications in the manufacturing of tampons and the selection of tampon materials. Various tampon leachables, as well as sterile cotton gauze leachables were inoculated with S. aureus, E. coli, and L. acidophilus (both mixed and pure cultures). Selective as well as non-selective agars were used to determine the growth patterns of each bacteria. In both pure and mixed cultures, Playtex super-absorbency tampon leachables impeded the growth of S. aureus. It was also found that Rely tampon leachables affect the normal competitive survival and advantage of bacteria in mixed cultures.

MICROBIAL FUEL CELLS

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Which microbe will generate maximum current in a voltaic cell? Four cultures of seven common microbes were used as the acidic portion of a voltaic cell by inserting copper/zinc electrodes. Lead wires were attached to a mili amp meter and readings were recorded. Four different re-dox dyes were used (few drops) - each dye in a new culture. Readings were taken at 1, 2, 4, 6 hour periods. Microbial metabolic activity enhanced the electron flow producing more current. Proteus vulgaris plus TBO produced more current than any of the other bacteria with the re-dox dyes used.

A duel chambered microbial fuel cell was constructed of plexiglass with H_2O sealer. Chambers were divided by an animal membrane. Anolyte chemicals were added to the left chamber (Anode) together with Proteus vulgaris and TBO to facilitate electron flow through the membrane. Catholyte chemicals were placed in the right chamber (cathode) to facilitate electron flow. This model produced lower quantities of current for one week duration compared to that produced by a simple voltaic cell for twenty-four hours. This model could be maintained for longer periods of time by feeding the bacteria.

HOW ANTISEPTICS AFFECT BACTERIA

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The purpose is to determine which anti-septic affects the growth of bacteria and what amount is needed. I mixed up nutrient agar in tubes, sterlized the tubes, inoculated tubes with escherichia coli, bacillus subtilis, and bean bacteria. I used mercurochrome, iodine, alcohol, scope, hydrogen peroxide, solarcaine, and merthiolate as antiseptics. Five tubes were used, four for the testing of antiseptics and the fifth for a control. I put one, three, five, and seven drops of antiseptics in each set of bacteria tubes. After I put the drops in the tubes I incubated the tubes for two days at 37°C. Then I recorded the turbidity, viability, and the growth of the bacteria to see which antiseptic stopped the bacteria growth.

My result was that merthiolate was the best antiseptic to kill the escherichia coli bacteria, mercurochrome was second, alcohol was third, iodine was fourth, scope was fifth, solarcaine was sixth, and hydrogen peroxide was seventh. With the bacillus subtilis bacteria merthiolate killed it the best, hydrogen peroxide was second, solarcaine was third, iodine was fourth, mercurchrome was fifth, alcohol was sixth, and scope was seventh. Merthiolate was the best to kill the bean bacteria, iodine was second, solarcaine was third, mercurochrome was fourth, alcohol was fifth, hydrogen peroxide was sixth, and scope was seventh.

DESULFURIZING COAL BY THIOBACILLUS FERRO OXIDANS

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The oil crisis demonstrated a growing need for an alternate energy source. Coal, considered one of the most likely sources to fill this need, presents a pollution problem due to its high sulfur content.

The objective of this project was to use bacteria, Thiobacillus ferro oxidans and thio oxidans, as a means for reducing the sulfur content of coal; therefore making it a valuable fuel.

After testing the growth capabilities of the bacteria in a coal environment, four tests were performed to evaluate its ability to process the sulfur found in coal. Processing rates were investigated by exposing the coal to the bacteria from one to sixteen days.

An Eschka test was used to evaluate the possible rate of sulfur removal. Test IV results suggest successful removal of sulfur from coal with the combination of Thiobacillus ferro oxidans and thio oxidans. Correlation coefficient for this data was -0.6781.

Tests I, II, III used Thiobacillus ferro oxidans alone. Tests II and III indicated an increase in sulfur content with increased exposure time. Correlation coefficients for these tests were 0.8120 for test III and an adjusted coefficient of 0.8406 for test II.

Test data indicates a reduction of sulfur content with the thio oxidans and ferro oxidans combination. Surprisingly, the ferro oxidans alone cause an increase in sulfur content. These conclusions should lead to very interesting future research necessary to understand and confirm this process.

#A SCREENING OF THE ANTIBACTERIAL AND MOLLUSCICIDAL PROPERTIES OF SOME TROPICAL PLANTS EXTRACTS WITH SPECIAL ATTENTION TO THE CHEMICAL COMPONENTS OF *Punica granatum* L. (Pomegranate) SPECIES

Melendez, Peter A., Colegio San Antonio, Isabela, P.R. 00662;
Ensanche Gonzalez #87, Isabela, P.R. 00662.

This study is an attemp to determine the possible antibiotic and molluscicidal effects of tropical plants of P.R. and to separate and identify the active compounds responsible for the antibacterial effects of *Pomegranate*.

Methanolic leaf extracts of all plants were tested for inhibitory action against 18 species of gram-positive and gram-negative bacteria. Fruit extracts of some positive plants were tested. Sensivity tests were carried out in M.H.Agar using the Kirby-Bauer Method. Extracts were applied using Difco Concentration Disks. Antibacterial effect was determined on the basis of the diameter of the inhibition ring in mm. Proper controls using different combinations of plates, bacterias and disks were used. Plates were incubated at 37°C. Comparison with know antibotics were also carried out.

Of all 200 plants, 15 gave positive results. Best results were: *P.granatum* (f) over 15 bacteria; *C.aurantifolia*(f) over 16; *C.aurantium*(f) over 17 and *P.acidus*(f) over 16 bacteria.

For the moluscicidal tests, the snail *Biomphalaria glabrata*, intermediate host of *S.mansoni* was used. Control of the snail will control indirectly schistosomiasis. Same 200 plants were tested. Snail was exposed to different concentrations such as 1000,500,200,100,50ppm. Control snail were used in all tests. Nine plants killed the snail at 200ppm.; 6 at 100ppm.; *Didymopanax morototoni* and *Mammea americana* killed the snail at 50ppm.

Chemical analysis of *P.granatum* involved methods like TLC, Column, Gradient Vaccum and Preparative Layer Chromatography and Infrared Spectra. Fruit contains ellagitannins. G.V Chromatography active fraction was separated using P.L.Chromatography. Spot #2 and #3 contained active material. Spots are being identified via Infrared Spectrum.

#Second Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

EFFECTS OF PESTICIDES ON MICROBIAL FLORA

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Microbial flora are the microscopic living things that incessantly occur throughout nature. This study deals with the microscopic organisms that live on plant leaves and stems.

The purpose of my project is to address the question as to what effect pesticides have on the microbial flora. This flora often serve as a natural defense system for the plant.

M9 broth was prepared and solutions of Round-Up, Treflan, Blazer and Toxaphene Spray were prepared. PY Broth solutions with Millet, Soy Bean, Sunflower, and Cotton were also prepared. After proper incubations, one gram of each foliage solution was placed into a flask containing each of the pesticides. Sterile petri dishes with M9 medium were inoculated using the spin plate technique. Plates were incubated for 48 hours at 28°C.

Having studied the colony morphology and growth rates of the microbial flora existing on the foliage on cotton, soy beans, sunflower, and millet it is positively concluded that microbial growth can be modified by use of various agricultural chemicals. Of the pesticides studied, Blazer had the greatest effect with a most noticeable modification in the lack of development of "normal" microbial growth. Treflan, Toxaphene, and Round-Up failed to produce a measurable deviation from the norm.

Failure to recognize the impact of microscopic modifications caused by such nonbiodegradable chemicals may someday generate comprehensive changes in the field of agricultural engineering.

#A COMPREHENSIVE ANALYSIS OF BACTERIOPHAGE DNA RECOMBINATION AND BACK MUTATION WHILE BEING SUBJECTED TO DIVERSIFIED MAGNETIC FIELDS

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Bacteriophage, viruses of bacteria, serve as DNA transfer systems among bacterial cellular systems. As documented by L. Sula, an increase in phage production results from exposure to as little as .8 gauss. The purpose of this research is to investigate the effect of various magnetic fields on DNA recombination and phage production.

Two mutants of *E. coli* T_4 rII bacteriophage were used: a deletion mutant of the A cistron (H88), and a point mutant of the B cistron (ED_b50). These mutants, which were aided in the recombinational process by *E. coli* S65, were placed in various magnetic fields ranging from .5 to 10000 gauss.

Phase I and II results both indicate that fields between 1000 and 2000 gauss enhance viral recombination and plaque production in a 2 to 1 ratio. Effects are assumed to be based on an increase in recombinational enzyme activity. Specific conclusions could lead to an explaination of cancerous cells, and practical applications of this process could be used at any time when viral research is done. Importance must be placed on research in this area because of the abundance of viral experimentation to today's fields of medicine, and the possibility of accelerating such research with magnetic field techniques.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

INCREASED RECOMBINATION FREQUENCY IN ESCHERICHIA COLI URACIL-DNA GLYCOSYLASE (ung) DEFICIENT MUTANTS

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Bacteriophage containing uracil in its DNA (uracil-DNA phage) was used to screen known mutants for their ability to grow uracil-DNA phage. RSS109, a hyper-recombinant strain among the collection of Konrad, was found to present a two-fold increase in uracil-DNA phage plating efficiency. The RSS109 mutation mapped to the region of the uracil-DNA glycosylase gene. Complementation tests revealed the RSS-109 allele to be dominant to ung-1 (0.05% activity) and recessive to ung+. After performing enzyme assays, the RSS109 allele was found to be an ung deficient mutant with 50% activity. This activity decreased at higher temperatures, a characteristic of deficient enzymes. By examining the recombinant behavior of other ung deficient mutants, a correlation was observed: as ung activity increases from 0%, recombination frequency does also, until uracil-DNA glycosylase activity approaches that of normal cells, where the recombination frequency returns to normal. Normally uracil bases are repaired immediately following their incorporation during replication. It is proposed that ung deficient mutants may continue the repair of uracil residues into the next replication cycle. If this repair occurred, it might lead to recA mediated single strand exchange to regain genetic information lost by excision of uracil from single stranded DNA, therefore causing the gyper-recombinant phenotype.

#First Award - United States Army
London International Youth Science Fortnight - United States Navy/ Office of Naval Research

#BENIGN MUTATIONS IN THE TETRACYCLINE RESISTANCE GENE

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In bacterial plasmid pBR322, there exists the gene responsible for bacterial resistance to the antibiotic tetracycline. By isolating, cloning, and sequencing the initial 600 base-pairs of this gene, the nature of the codon protein expression can be derived. From this codon sequence, conclusions can be drawn as to what types of codon-repressing mutations can occur without affecting the gene fragment's proper expression.

It is hypothesized that, because of the large size of the gene fragment, many different codons would be used and no benign mutations (derived from unexpressed but possible codons) could be identified. The pBR322 fragment, located between the HindIII and SalI restriction endonuclease sites, was ligated into M13mp18 and M13mp19. These two M13 viral strains were then allowed to infect JM101 bacteria cells, thus producing clone phages of the plasmid fragment incorporated into the virus. The single-stranded viral DNA was used as a sequencing template and an acrylamide sequencing gel was run. Utilizing the dideoxy method (Sange et al.), the base sequence of the fragment was read from an x-ray photograph and was translated into the amino acid codons.

Upon examination of the codon sequence, specific benign mutations for five amino acids (codon repression) in this gene fragment were identified. Thus, if these mutations (causing the repression of the identified codon's expression) were implemented, the expression of this gene would be unaffected.

#First Award - United States Air Force

AN INVESTIGATION INTO AGONISTIC BEHAVIOR OF CERTAIN PROTOZOA

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Protozoa, like all other creatures in nature, must have some form of fefense against their enemies to insure their continued existence. To determine what specific methods of defense are utilized by various single-celled animals, a series of experiments was organized matching a certain species of protozoa against a known, single-celled predator. The two carnivorous specimens used as predators were Dileptus anser and Didinium nasutum. These two protozoa were introduced into cultures of two larger ciliates, Spirostomum ambiguum and Stentor coeruleus. They were also introduced into cultures of Paramecium aurelia, Paramecium bursaria, and Paramecium caudatum.

Results of these confrontations showed that although the various species of Paramecium were able to defend themselves effectively against Dileptus by use of trichocysts, hard outer pellicles, and superior swimming abilities, they were no match for the pexicysts and toxicysts of Didinium. Dileptus, which also has toxicysts, was able to overcome the larger ciliates and sometimes a number of Dileptus would attack simultaneously to do so. Didinium, however, would not attack the larger ciliates. The fact that Didinium attacked only Paramecium even though its pexicysts and toxicysts enabled it to easily defeat the larger opponents might suggest that Didinium had a preference for Paramecium only and chose not to attack.

STREPTOKINASE AS A TECHNETIUM LIGAND FOR LOCALIZATION OF THROMBI AND EMBOLI/DILUTION END-POINT ASSAY FOR STREPTOKINASE

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The main objective in this investigation is to determine whether 99mTc-Streptokinase retains the high affinity of Streptokinase and if it can consequently be used as an imaging agent for radiologic localization of blood clots. In this manner, surgeons can locate a blood clot in a patient so that it can be removed.

Streptokinase (SK) is a protein produced by several strains of Streptococcus. It activates plasminogen, found inert in the blood, into plasmin, which dissolves the fibrin that makes up a clot.

In this investigation, Group C Streptococcus (strain H46A) was grown on a peptone glucose medium. The pH was maintained at 7.2-7.4. When acid production stopped, the culture was centrifuged. The supernatant was then sterile filtered, concentrated by ultrafiltration, ethanol precipitated, and chromatographed on a Sephedex G-100 column.

A dilution end-point (D.E.P.) assay for SK was also developed. SK sources were serially diluted with sterile gelatin-phosphate-saline buffer in microtiter plates. Sources of plasminogen, fibrinogen, and thrombin were added; the plates were then incubated at 37 C. When lysis was complete, dilute charcoal was added to each well for sensitization of the end-point. The D.E.P. is the highest dilution (smallest concentration) of SK yielding complete lysis.

The highly purified SK was then tagged with 99mTc-SK at pH 5.0 in the presence of stannous chloride. It proved to be a satisfactory ligand. Fibrin was then added to the 99mTc-SK. In a Gamma ray-counter, it was found that the 99mTc-SK attached to the fibrin.

Therefore, 99mTc-SK can be used as a tool for the surgeon to locate blood clots in the human body.

#Third Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

MONOCLONAL ANTIBODIES AGAINST INFLUENZA TYPE A INFECTION IN VITRO

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The possibility of an effective means of immunization against viral disease by the administration of preformed antibody has come about by the relatively new development of hybridomas which secrete monoclonal antibodies. It was the objective of this research to determine the ability of monoclonal antibody to provide immunity to infection with Influenza A/Puerto Rico/8 (H1N1) in vitro. It was hypothesized that monoclonal antibodies would afford some protection against the influenza.

Madin-Darby Canine Kidney (MDCK) cells were divided into three groups: Gp. A cultures were infected with the PR/8, (infection in all cultures was verified via hemadsorption), Gp. B were infected with dilutions of Anti-PR/8 (HA) monoclonal antibody and a standard amount of influenza virus, (Dilutions of antibody: two-fold 1:2,000-1:128,000), and Gp. C cultures were infected with PR/8 virus mixed with a 1:2,000 dilution of a non-specific monoclonal antibody (Anti-Bangkok). Both suspensions of monoclonal antibody were checked for high concentrations of immunoglobulin via acetate and paper electrophoresis.

Gp. A, the infected controls, and group C, the non-specific antibody controls both displayed positive hemadsorption thus indicating infection. Gp. B cultures remained uninfected to the 1:32,000 dilution. Cultures from 1:64,000 and 1:128,000 dilutions were positive for infection.

It was concluded that high titer monoclonal antibody provides an effective preventative to in vitro influenza infection. It was also concluded that monoclonal antibody suspensions may provide a reliable preventative for the last remaining cause of pandemic infectious disease.

#Second Award - General Motors ISEF

THE EFFECT OF VARYING THE NUTRITIONAL REGIMES ON THE GROWTH OF AGROBACTERIUM TUMORS IN LYCOPERSICUM (sp)

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Agrobacterium tumerfaciens causes tumors to form in plants. This tumor induction involves the transfer of a portion of tumor-inducing (Ti) plasmid DNA from the bacterium to the plant cell. The addition of fertilizer will have an effect on the tumors and will cause their growth rate to differ from the non-fertilized plants.

Agrobacteria were cultured on yeast extract glucose because the growth rate was slower in forty-eight hours. Dilutions were made until absorbencies of .48, .27, and .17 were obtained. These dilutions were used for the inoculations of Lycopersicum.

Inoculations of three different concentrations were applied to twelve fertilized and twelve non-fertilized plants. Each group of twelve plants were divided into four groups (A,B,C,D) of three plants each. All groups were inoculated at nine points along the vertical axis, one and a half cm. apart. Group A was inoculated with the highest absorbency of .48, Group B with .27. and Group C with .17. Group D was inoculated with all three concentrations.

The tumor growth was smaller on the non-fertilized plants. The non-fertilized plants began to die above the last vertical inoculation. The A plants died first. The C plants with the least bacteria concentration lived the longest.

The fertilized plants had larger tumors. The C plants with the least concentration grew best. The A plants died the most rapidly.

#First Award - American Medical Association

#FORMATION OF BAM-HI GENOMIC CLONE LIBRARIES TO ISOLATE ALGINIC ACID GENES FOUND IN CYSTIC FIBROSIS ISOLATES OF PSEUDOMONAS AERUGINOSA

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Often, Pseudomonas aeruginosa strains isolated from the lungs of cystic fibrosis patients produce an acetylated exopolysaccharide commonly called alginic acid. The pathway of alginate biosynthesis by P. aeruginosa and its genetic controls are unknown. To better understand alginic acid produced by P. aeruginosa in cystic fibrosis patients, it is mandatory to gain a greater knowledge of the genes responsible for alginate production.

Previously, a clone bank of stable mucoid DNA was formed using partially digested Sau-3A. The bank was screened by a transformation procedure and potential alginate clones could have been identified by a tetracycline-sensitive, carbenicillin-resistant phenotype. No alginate genes were found using this method. Published results, along with personal observation, have shown that attempts to complement various non-mucoid strains to Alg^+ often meet with failure.

Thus, the formation of a cosmid library seemed to be a more efficient method to isolate alginate clones. Four non-mucoid mutants which were Alg^- were isolated by transposon mutagenesis. A cosmid library was then formed by digesting stable mucoid DNA from FRD130 and cosmid vector pCP13. After packaging in lambda particles, the recombinant DNA was transfected into E. coli. The clone bank of some thirty-eight thousand clones was mated with transposon mutants and MOB269 (an E. coli strain which carries helper plasmid pRK2013). Six potential alginic acid clones were isolated and are currently being examined to determine if they do in fact contain genes which regulate alginate biosynthesis.

#First Award - United States Navy/Office of Naval Research
Second Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

HOW DO VARIABLES AFFECT PHYSARUM POLYCEPHALUM?

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This project is a three-year study of the Physarum polycephalum, an acellular slime mold that is unique in that it goes through two separate and easily observable life cycles, one of which is plant-like and one of which is animal-like. Although scientists at the University of Kansas have succeeded in isolating the change "trigger" and forcing an early change to the plant-like stage, little else has been written about the characteristics of this type of slime mold, except this application in cancer research.

Five types of tests were conducted to identify the characteristics of Physarum polycephalum. The first tests showed how growth rates and extents were influenced by varying the food media applied to the cultures. The second tests showed how cultures grown on varied concentrations of nutrient agar, filter paper, rotting wood, or rotting leaves differed in growth rates and extents when both distilled and tap water were used. The third tests showed the changes in growth rates and extents in agar bases with varying concentrations of endol acetic acid, a growth stimulant. The fourth tests showed the animal-like reactions of the cultures to light, hydrochloric acid, and cutting. The fifth tests showed the changes in growth rates, extents, and directions when an electromagnetic field was created under the petri dishes which held the cultures.

* SAGE, A NATURAL PRESERVATIVE?

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For centuries, herbs have been used to cure illnesses and heal infections. In this project sage was tested as a killing agent against Bacillus subtilis. Sage had a large kill practically every time it was tested.

Sage was initially mixed in a 0.9% NaCl solution, but when filtered and tested against the bacteria, no inhibition was present. It was concluded that the killing substance was not water soluble. The sage was mixed with both chloroform and alcohol, then filtered. Sage was found to be soluble in both solutions.

Chromatograms in both chloroform and alcohol were conducted. The chromatogram done in the alcohol showed no separation areas. However, in chloroform there was one separation area. It was tested against bacteria and was effective. Tests for the presence of protein, tannin, volatile oil, and an alkaloid were negative. Six separations occured on thin layer chromatogram.

Tests show that the killing agent is not water soluble, a protein, a tannin, a volatile oil, or an alkaloid. It can also be concluded that the killing agent is a mixture, instead of a pure substance.

*First Award - American Indian Science and Engineering Society

THE EFFECT OF OZONE ON GROWTH INHIBITION OF ESCHERICHIA COLI

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With the recent discovery of a link between chlorine and the formation of carcinogenic trihalomethanes in water treatment facilities, there has been an increased interest in the use of ozonation as a safe substitute.

This study examines the effectiveness, under laboratory conditions, of ozone in retarding growth of Escherichia coli, a bacteria commonly found in sewage. Observations were made and conclusions drawn.

THE ROLE OF ETHYLENE AS AN INHIBITOR OF THE NEMATOPHAGOUS RESPONSE IN A. CONOIDES

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The use of a nematophagous fungus as a biological control to prevent damage to root crops is preferred to the utilization of chemical nematocides, since the local ecology remains undisturbed and the control easily becomes part of the ecosystem. Previous investigations using the Imperfect fungus Arthrobotrys conoides indicated that the highest degree of predacity is maintained when the nutrient levels in topsoil are minimal. Subsequent investigations suggested that selected macronutrients deter trap organ formation, but not to the same degree. The most opportune time to apply the nematophagous A. conoides would be in the fall when nutrient levels have been depleted. Since levels of ethylene are higher during the fall season, the effect of ethylene on the predacity of this fungus was also investigated. Results have clearly indicated that the ethylene acts as an inhibitor of predacity in A. conoides. Most recent research was designed to determine the mechanism of this inhibition. The results indicate that ethylene acts primarily on the nemin precursor, altering it in some way which prevents its modification to nemin. There is also some evidence to suggest that the proposed enzyme which converts the nemin precursor to nemin may be affected to some degree.

#"Separate and Combined Effects of Carbon Monoxide From Ambient Cigarette Smoke and Tetracycline-Resistant Staphylococcus epidermis on the Pulmonary Immune Respone in Laboratory Mice"

by Kevin Warstler from John Adams High School
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It has been found that the incidence of drug-resistant bacteria has been on the increase causing a major problem in medical science (Johnston, 1983). Also, the reduction of the immune response due to carbon monoxide from ambient cigarette smoke has been on the rise (Snella, 1979). The hypothesis was that both the separate and combined effects of tetracycline-resitant S. epidermis and the carbon monoxide would cause a reduction in the immune response.

Two of four groups of mice were maintained on CO from ambient cigarette smoke while a tetracycline-resistant strain of S. epidermis was developed. At +6 weeks, the mice were injected with the non-resistant bacteria and the resistant bacteria. Mass changes, differential WBC counts, % phagocytosis, leukotaxis, and IgG concentration were determined.

The results showed that CO does alter mass changes, differential WBC counts, % phagocytosis, leukotaxis, and IgG concentration. The tetracycline-resistant S. epidermis and the combined effect with the CO reduced % phagocytosis and leukotaxis.

#Second Award - United States Army

THE DETECTION AND CONFIRMATION OF HISTAMINE-PRODUCING BACTERIA IN FISH

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The consumption of fish containing a high level of free histamine is associated with scombroid food poisoning. When fish are not properly refrigerated or frozen soon after being caught, histamine-producing bacteria can rapidly multiply and convert the histidine to histamine. This research was conducted to determine the amount of histamine-producing bacteria in fish.

Five species of fresh and spoiled fish were assayed. The fish assayed were croaker, mullet, small bass, speckled trout, and mackerel for histamine-producing bacteria. The samples were homogenized with sterile phosphate buffer. Serial dilutions were made and 1ml of each desired dilution was placed in a sterile petri dish to which differential agar medium was added and swirled gently to mix. The plates were incubated at 35 ± 2° C for 24 ± 2 hr. The histamine--producing bacteria are characterized by a purple zone surrounding the colonies against the yellow background color of the differential agar medium. A second test was performed to confirm the presence of the histidine decarboxylase enzyme. Histidine decarboxylase activity was detected by the development of a purple zone surrounding the bacterial growth as previously indicated.

The results of this study have shown that fresh fish contain lower amounts of histamine-producting bacteria than spoiled fish. The opportunity is very great for scombroid food poisoning to occur, but only if high levels of histidine are present in the fish's flesh.

#ANALYTICAL RESEARCH OF PHOTOTAXIS AMONG EUGLENA GRACILIS UNDER THE VISIBLE LIGHT FIELD OF THE ELECTROMAGNETIC SPECTRUM

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Euglena gracilis, a photosensitive, unicellular, algal flagellate, has been known for its ability to quickly adapt to various wavelengths giving this protozoan an extraordinarily high survival rate. The intent of this project was to determine the necessary morphological changes that occured due to adaptation to different wavelengths and to different intensities. The conclusions could then explain the experimental data of the phototropic behavioral responses. By changing filters upon the light source different wavelength regions could be controlled. Varying intensities were observed as well. Essentially, the upper regions of the spectrum initiated negative behavior (i.e. shuddering, fracturing) whereas the lower regions initiated positive behavior (i.e. grouping, gyrating). Laser application determined that light seemed to serve as a "trap" isolating those inside and outside the beam. The cultures were prepared for transmission electron microscopy (TEM). Two regions of the solar spectrum were to be studied (400-450nm/BLUE, 610-700nm/RED). These two regions represented opposite sides of the spectrum so as a viable representation could be given. Following standard TEM methods the specimens were observed and their morphological changes were noted. The photomechanism of the euglena (i.e. stigma, chloroplasts, mitochondria) was adversely affected. The 400-450nm region seemed to fracture the organelles concerned with phototropic responses. The cell matrix of the euglena at the 400-450nm region was sparse with very little identifiable organelles. Comparatively, in the higher region, the 610-700nm, the matrix was well-defined; however, compared to the control, there seemed to be some degrading of the organelles.

#First Award - Eastman Kodak Company

AN IDENTIFICATION AND COMPARISON OF MICROBIOLOGICAL CONTAMINANTS ISOLATED FROM BULK AND PREPACKAGED FOODS

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The purpose of this project was to test bulk and prepackaged foods for contamination. If contamination was found, the bacteria was identified in order to determine if the contaminants were harmful to man. Bulk foods may be defined as foods sold out of plastic containers rather than the packaging most of us are accustomed to. With everyone handling and packaging this food, it would seem to allow for additional contamination. When buying bulk, one must consider the risk involved in eating a contaminated product. Is it harmful or not?

The first step to determine the risk was to choose six products: cheese balls, chocolate-covered raisins, cookies, corn flakes, peanut butter, and onion rings. These items were represented by both bulk and prepackaged foods. These foods were inoculated onto three agars. After incubation, tests were done to identify the unknown colonies of contamination.

Non-pathogenic contamination was found in both bulk and prepackaged foods. Although these foods are indeed contaminated, the identified bacteria are thought to be harmless. Both kinds of food products are probably safe for human consumption. Tests showed that some of the bulk foods were probably contaminated by human handling. Because of this fact, the practical application would be to devise better methods for dispensing bulk foods. Further tests should be done to identify other isolated bacteria.

#DIFFERENTIATING BETWEEN COLIFORMS FROM HUMAN AND COW FECES

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Some freshwater lakes are contaminated by the fecal pollution indicator, Escherichia coli. When E.coli is found in lakes its origin can't be determined. There is no procedure at the present time to differentiate between human and cow E.coli. Determining the origin of E.coli, either from residential or agricultural areas, has become increasingly important. Once the origin is identified, it will be known what exactly is polluting the water, and steps can be taken to stop or decrease the incoming pollution.

The biochemical reactions contained in the API system were tested on differentiating between the two Coliforms. In Phase 1 pure strains of human and cow E.coli were run separately through the API system. The chemical reactions on both types of E.coli were compared. In Phase 2 water samples were taken and E.coli separated. The E.coli was run through the API system. The bacteria was identified and the chemical reactions were compared with the data from Phase 1. During Phase 3 a broth containing both human and cow E.coli was run through the API system. The bacteria was identified and compared with the data from phases 1 and 2. The results from all phases turned out to be useful in developing the steps toward identifying the human and cow E.coli. More tests will be performed in the Future to obtain a procedure for differentiating between human and cow E.coli that cause the lake pollution.

#Third Award - General Motors ISEF

MOLECULAR AND CELLULAR EVENTS DURING THE YEAST-TO-MYCELIUM CONVERSION IN CANDIDA ALBICANS

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Candida albicans, a dimorphic fungus, is the principal opportunistic pathogen causing mycotic infections in humans. The yeast-to-mycelium conversion can be used as an eukaryotic model of morphogenesis differentiation. The first part of this project studied the yeast-to-mycelium conversion of a C. albicans (H317) population under controlled laboratory conditions. Two methods were used with the purpose of obtaining synchronization in the conversion: (1) a cold (4°C) treatment of the yeast in stationary phase of growth, and (2) transfer of a yeast culture to an inorganic salts medium without a carbon source. The mycelial growth induction of both yeast cultures was made by increasing the temperature (37°C) and by dilution in fresh medium. Samples were taken at selected time intervals and the amount of singlets, buds and mycelia was counted by the use of light microscopy. The synchronization of the yeast to form mycelia was determined in terms of percentage of mycelia and mean hyphal length. Cells from each sample were stained with either a fluorochrome specific for the nuclei or septa. Septation and nuclear division during germ tube formation were assessed by using fluorescence microscopy. The second objective of this project was to evaluate the effects of hydroxyurea, an inhibitor of DNA replication, on the yeast-to-mycelium conversion. Results showed that the method involving depletion of nutrients produced a better synchronization on the yeast-to-mycelium conversion of the population, and that the inhibition of DNA replication retarded mycelial development, septum formation and totally inhibited nuclear division.

COMPARATIVE STUDIES OF ACNE AGENTS NON-PRESCRIPTION DRUGS VS. PRESCRIPTION DRUGS

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Acne is one of the most common skin disorders. It is an inflammatory disease and indications are that it is caused by a hormonal imbalance and aggravated by bacterial infection. This study was undertaken to test and compare the effectiveness of prescription and non-prescription agents on specific bacteria from acne lesions.

Cotton swabs were used to collect specimens from acne lesions. Isolated bacteria were then identified using the Gram stain, catalase and coagulase tests, and anaerobic cultivation under anaerobic conditions.

A specific amount of prescription and non-prescription agents were added to a standardized concentration of each organism on an agar plate. After 24 hours of incubation the zone of inhibition for each drug on each organism was measured.

The results obtained in our laboratory indicated that the prescription and "over-the-counter" drugs showed approximately the same effectiveness for each organism with the exception of the antibiotic prescription drug which contained 2% erythomycin which was far more effective than the other drugs tested.

#A MICROBIOLOGICAL AND STATISTICAL STUDY OF THE MORMODICA CHARANTIA EXTRACT EFFECTS AND SOME SORT OF FUNGIS AS A BIOLOGICAL CONTROL "in vitro" AGAINST THE DERMATOPHYTE FUNGIS.

RIVERA, WILLIAM., HEMETERIO COLON SCHOOL,PONCE,P.R.
JOSEPH DE TORO STREET,LAS DELICIAS ,PONCE,P.R. 00731

The purpose of this study is to determine the microbiological effect of the M. charantia extract and some sort of fungis to control biologically "in vitro" the dermatophite fungis M. audouinii which causes of the Tinia Corporis and Tinia Captitis in humans and animals skins. The initial phase of this research was based on the recopilation of the M. charantia plant to carry out some biochemical test with the same plant.The second phase consisted in determining which are the dermatophite fungis which mainly affect our people in P"R. The third phase consisted in finding out the growth frequency of the patogenic fungis to carry on sensibility tests with the extract.The fourth phase was based of the summarization of various fungis found in the air and use them as biological controls"in vitro" to the dermatophile fungis M. audouinii.During the first pahse,three experimental zones were established and it was revealed that the plant consists of 20%water,9.8% O.materia and .027 minerals.the only pigment in the plant is Chlorophyll A.In the second phase we found:M.audouinii,M. gypseum,M.canis,T.mentagrophite,T.tonsurans,T.violaceum,T.concentricum,T.knoxdaviii with attack the people.The third phase showed that the M.audouiniistarts its reproduction with an geometric increase around the second day it was cultivated.this based 14 days.this test helps us to know the answer to the fungis to the vegetable extract once the fungis be adapted to the enviroment where it grows. the sensibility tests tesured that the concentration of 40% reduces the number of spores by milliliter to onehalf.This implies that a fungis infection may be reduced to almost 50% of its pathological effect.The variance analysis revealed there is a meaningful difference in the treatment of the different concentration of the M.charantia extract.The four part revealed that the A.niger,A.oruzar,Penicillium,Cladosporium,Gongromela and Bisochami have the capacity to control the pathogenic fungis "in vitro" M. audouinii.The analysis of variance to demostrate statistically that the results that we obtained of both tests were not be a rendon,but the antagonist affect significantly and adversely the growth of M. audouinii.This biological control give the facility of its uses as quimioterapeutic agent in the treatment of skin infection.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

THE EFFECTS OF ANTIBIOTICS AND ANTIMETABOLITES ON PATHOGENIC AND NON-PATHOGENIC BACTERIA, AND THE USE OF ANTIMETABOLITES AS AN INSECTICIDAL AGENT

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I inoculated the blood agar plates with Streptococcus pyogenes, Streptococcus lactis, Staphylococcus aureus, Staphylococcus epidermidis, Escherichia Coli, Lactobacillus bulgaricus, and Staphylococcus epidermidis taken from the skin. I also used Mueller-Hinton agar for Staphylococcus aureus. I used Saubouraud dextrose agar for Bacillus subtilis. Simple, Gram, and acid-fast stains were prepared. The Kirby-Bauer method was used to test 22 antibiotics. I transferred mold growth into a test tube containing trytic soy broth and glucose. These cultures were left to grow for one week. I used the disc-diffusion method to test the antimetabolites. All of the plates were incubated at 37 degrees C. for 24 hours before the data was recorded. The mold solutions were sprayed onto the long horned woodborer belonging to the order Coleptera in order to determine if mold growth could be used as a natural insecticide. The antibiotics that were the most effective on pure cultures of bacteria follow: Streptococcus pyogenes Penicillin G, Staphylococcus aureus-Penicillin G, Staphylococcus epidermidis-Ampicillin, Escherichia Coli-Carbenicillin, Bacillus subtilis-Cefaperazone, Streptococcus lactis-Cefaperazone, Staphylococcus epidermidis taken from the skin-Chloramphenicol. Of the 24 molds I tested 21 produced an antimetabolite. This is approximately 88%. The mold cultures reached their peak of production after about 15 days. Their strength began to decline after about 30-35 days. The antimetabolites tested on the long horned woodborer seemed to affect its nervous system causing a loss of coordination and disorientation. Although the antimetabolites did not kill the insect immediately, the insect did eventually die.

A COMPARATIVE ANALYSIS OF EFFECTS OF SOIL BACTERIA ON PLANTS

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The purpose of this project was to determine at which stage or stages in plant life the absence of helpful soil bacteria is most devastating. Experimentation was designed for the germination, growth and productive stages.

Phase I: In phase I identical seeds were planted and grown in the same environment. Soil for the experimental and control groups was the same except that soil for the experimental group was heated one hour at 500 to kill bacteria. Helpful bacteria identified were Nitrobacter agilia, Nitrobacter winogradskye and Nitro somonas. The conclusion was based on the length of germination, the number of seeds germinating, and the vigor of plants.

Phase II: Phase II experimentation tested the effect of soil bacteria on plants during their growing stage. Plants were pair matched for size and vigor. Transplants were used to eliminate the detrimental effects caused by the absence of bacteria during the germination period. The analysis was made from the amount of growth and plant vigor through maturity.

Phase III: Phase III will be a study of long-range effects on phase II plants with emphasis on productivity. The conclusion will be determined from the plant's age at the time of productivity, amount of productivity and length of productivity.

Conclusion: Two years of researching and experimenting led to the following conclusion: Plants germinate in a shorter time period and grow faster and larger when soil contains helpful bacteria. The absence of bacteria is more detrimental to germination than growth. Phase III will measure the inhibition through production.

#A POSSIBLE GENE WHICH PREVENTS NODULE FORMATION IN THE ROOTS OF SOYBEAN PLANTS

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Symbiotic nodule formation is the process by which a single bacterium enters the root cell of a legume plant and multiplies to form a nodule. This nodule formation is extremely important because it is the preparatory step which eventually leads to protein synthesis within the legume plant. Legumes are a major food and protein source worldwide. Therefore, research in this area will eventually lead to hardier legume crops which will yield more protein and will not require costly, man-made, nitrogen fertilizers. Rhizobium japonicum PRC205 is a strain of the bacteria which specifically induce the formation of nodules on soybean roots. However, a gene may exist within a plasmid (circular ring of DNA) called pJB5 which prevents the nodule forming process. Strains containing pJB5 cannot induce nodule formation. To further test this hypothesis, these strains containing pJB5 were mutated. If pJB5 is deleted in the mutant, nodulation ability should be restored. Upon examination for plasmid content, it was found that some of these mutants had suffered a complete deletion of pJB5. Nodulation ability was indeed restored in these strains. Some mutants seemed to have pJB5 still intact. These strains did not regain the ability to nodulate soybeans. These findings further support the hypothesis that a nodulation repressor gene(s) exists within the pJB5 plasmid.

#Third Award - General Motors ISEF

MOCK EPIDEMIC OF SERRATIA MARCESANS

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RESEARCH: The epidemic diseases have marked some of the most cruel and horrible mortalities in the history of mankind. Yet, it is possible to interrupt the chains of transmission or even eliminate the source by detecting the routes of transmission of disease-causing agents.
HYPOTHESIS: Based on contaminations and the inhibition zones I hope I will discover the pathways and susceptabilities of Serratia marcesans.
PURPOSE: By performing a mock-epidemic demonstration and testing three antibacterial agents I hope to prove my hypothesis.
PROCEDURE: Each experiment was conducted as follows:
A. Mock-epidemic Demonstration
1. Each of the ten "guinea pigs" wore a rubber glove on one hand, and one of them directly contacted with the bacteria. 2. Each "guinea pig" shook hands with another randomly. 3. Bacteria from each one's glove was swabbed and transferred to petri dishes. 4. After 72 hours bacteria on most of the dishes were fully grown.
B. Susceptability Test
1. Serratia marcesans was swabbed thoroughly on a petri dish. 2. Each three sterile disks were dipped into ethanol, bactine, and chlorox, respectively. 3. Disks then were placed on a petri dish with nutrient agar. 4. After 50 to 72 hours of incubating, each of the three showed distinct inhibition.
RESULTS: The bacteria were spread out as following orders: from 1,9,7,2,10,6,8,3,4, to 5. Ethanol was found to be the best antibacterial agent.
CONCLUSION: In the physiological aspect I was able to trace the chains of transmission based on contamination. On the other hand I discovered that Serratia marcesans was the most susceptable to ethanol.

MAPPING GENETIC RECOMBINATIONS OF GENOME TRANSFER DURING INTERRUPTED CONJUGATION OF ESCHERICHIA COLI: PHASE III

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Bacterial conjugation is a process of cell to cell contact involving the oneway transfer of the genome and the episomes from a donor to a recipient strain. F+ cells carry an F (fertility) factor episome. The F factor can become a part of the host bacterium's chromosome, making it a High frequency recombinant (Hfr). The purpose of this project was to study bacterial conjugation and genetic recombination by (1) accomplishing genetic mutation of the Hfr, (2) conjugation with the F- to obtain recombinants, (3) conducting a mutant search to find temperature-sensitive mutants, and (4) mapping the genetic recombinants to determine the order of genome transfer and the point of temperature-sensitivity transfer.

The test organism, Escherichia coli, carries the F episome for bacterial conjugation. In Phase I, recombinants were produced through conjugation and incubation of stock cultures CSH 61 (Hfr) and CSH 50 (F-). In Phase II, a mutant search was conducted using grid plating techniques and incubating plates at 30°C and 37°C. Mutants were found that would mate at 30°C but not at 37°C. In Phase III, conjugation of the control (parent) strains was interrupted and examined for genome transfer by genetic mapping. The temperature-sensitive mutant from Phase II was then mated with the F- parent strain and incubated at 30°C and 37°C. Conjugation of the temperature-sensitive mutant was interrupted at the same time intervals as the control, examined for genome transfer, and mapped, indicating the time interval when the genome for temperature-sensitivity was transferred.

This type of research gives a better understanding of the process of genetic recombination, which is vital to the survival and evolution of higher organisms.

HOW IS THE GROWTH OF STREPTOCOCCUS THERMOPHILUS AND LACTOBACILLUS BULGARICUS AFFECTED BY pH AND TEMPERATURE VARIANCE?

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It has been accepted that yogurt is a healthy addition to the diet. The work of two bacteria, Streptococcus Thermophilus and Lactobacillus Bulgaricus, present in yogurt give it this beneficial reputation.

This project explores the growth of these bacteria when subjected to factors varying pH and temperature.

There are two sets of factors I used to determine the growth. The first set imposed by those marketing yogurt are freezing, heating, fruit on the bottom, and fruit mixed in. The second set, imposed by the human body itself, is the pH of the stomach.

Using the serial dilution technique, I was able to obtain a culture that held an accountable amount of these bacteria which were being tested by alternating the variables either before, after, or during serial dilution.

In conclusion, I can state that temperature and pH have a wide range of effects on these bacteria. They can survive at freezing temperatures as low as 5 F, but cannot survive high temperatures that exceed 122 F.

Adding fruit before fermentation and after alters the pH and does change the amount of bacterial growth and therefore can reduce the benefits of yogurt.

Yogurt must be eaten in large quantities (6 oz.) in order to pass through the stomach (pH of 2) to start their work in the large intestine.

A COMPARATIVE STUDY OF THE ESTUARINE ZONE OF THE MAYAGUEZ BAY WITH EMPHASIS ON THE RELATIONSHIP BETWEEN THE ENTEROBACTERIACEAE AND THE CHEMICAL ANALYSIS OF THE WATER FROM NOVEMBER, 1984 TO APRIL, 1985.

Arnau, Noel, José De Diego High School, Mayaguez, P.R. 00708;
Urb. Ramirez de Arellano, 106 Agustín Stahl St., Mayaguez, P.R. 00708.

The problem of environmental pollution is steadily increasing. Urban areas greatly contribute and are most affected by this problem. This investigation hopes to establish the relationship between enteric bacterial populations and the aquatic habitat they are found in to observe the characteristics of urban water pollution. Four bodies of water were chosen each with different physical characteristics but all draining into Mayaguez Bay. Five stations were identified representing zones of the estuary. Each of these stations were monitored for a period of six months.

Chemical tests were conducted for: water hardness, alkalinity (in $CaCO_3$), CO_2, dissolved O_2, PO_4, NO_3, pH, salinity and dissolved solids. Environmental temperature was taken on land and water.

Results were related with different species of enteric bacteria that dominates each station. To isolate these bacteria, they were inoculated into an enrichment broth, thioglycollate, to estimulate growth. From this they were passed to a selective medium, Salmonella-Shigella or Hektoen Enteric Agar, to another differentiating medium such as MacConkey Agar or Eosin-Methylene blue agar. Blood agar was used because it does not inhibit. To identify bacteria we used Api 20E Enteric System, TSI agar, urea agar slants or broth and for lactose-fermenting the reagent for indole, methyl-red, Voges-Proskauer and citrate. All were carried out under most sterile conditions possible.

For this comparative study I used the value of T cal. It is a statistical value to probe the probability of similarity between the four bodies of water, demonstrated by the same. Sorensen's Coefficient, Affinity and Similarity Indexes were used to compare microbiology of areas. Only three of stations compared showed similarities. It has been shown that the biological correspond to water in question. This is due to physical factors such as salinity, amount of dissolved wastes and presence of different types of pollutants.

Enteric bacteria can exist in a relatively alkaline environment with a pH varying from 7.4 to 8.1. There is an association between the enteric bacteria in the estuarine zone in Mayaguez with the concentration of PO_4, B.O.D., dissolved O_2 and the salinity.

THE EFFECT OF BACILLUS SUBTILIS, ESCHERICHIA COLI, AND STAPHYLOCOCCUS ALBUS ON THE DETECTION OF ANTIBIOTIC PRODUCING FUNGI IN FARMING SOILS

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The purpose of this investigation is to determine whether Bacillus subtilis, Escherichia coli, and Staphylococcus albus aid in the detection of antibiotic qualities in certain soil molds. Soil samples were obtained from tobacco and sugar cane fields on the east bank of St. James Parish. A small amount of each sample was mixed with water and put on Czapek's medium in a petri dish to allow mold to grow. After a 48-hour incubation period, pure cultures were grown on a corn meal medium and incubated for 72 hours. Following incubation, the mold was identified through microscopic observation. Nine pure bacteria cultures were innoculated with these mold cultures and checked occasionally under flourescent light for evidence of antibiotic qualities, indicated by a halo or clear area around the bacteria.

Bacillus subtilis (gram +), and Staphylococcus albus (gram +), both showed evidence of the antibiotic properties contained in the soils. Escherichia coli showed none. I noticed that Escherichia coli was also the only gram negative bacteria used. This quality had a direct effect on my results and proved that Escherichia coli is not a helpful aid in detecting antibiotic properties in soil molds.

#PATHOGENIC ENTERIC BACTERIA OF DRINKING FOUNTAINS.

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This experiment was performed to detect the presence of pathogenic enteric bacteria of drinking fountains. I tested twelve drinking fountains in my vicinity. I tested the moist surfaces of the drinking fountain and the drinking water. I also tested the untreated and the treated water at two water treatment plants and for water leakage in the pipe system between the water treatment plant and each of the drinking fountains. There were two procedures used for the testing of the drinking fountains. The first procedure tested the moist surfaces of the fountain where a person might come in physical contact with the fountain. This procedure involved basic plate streaking methods. The second procedure tested the drinking water, the treated and the untreated water at the water treatment plant, and for pipe leakage between the water treatment plant and each of the drinking fountains. This procedure involved the Membrane-Filtration Method. Both of these procedures allowed for an accurate count of the bacteria.

After my experiment, I found Escherichia coli, this was the only enteric bacteria belonging to the group Enterobacteriaceae that was present on the fountains. I found three nonfermenting gram-negative bacilli. These were Pseudomonas aeruginosa, Flavobacterium meningosepticum, and Pseudomonas fluorescens. I also found Staphylococcos epiderimidis, Bacillus subtilis, and Mycelia sterilia.

Although Pseudomonas aeruginosa and Flavobacterium meningosepticum can be considered pathogens, I feel that the drinking fountains are safe to use by a healthy strong individual.

#Fourth Award - General Motors ISEF

#INNER-CHICKEN WARFARE: THE FIGHT BETWEEN ANTIBIOTICS AND BACTERIA

Johnson, Sarah K.S., Dixie H.S., Due West, SC 29639; P.O. Box 368, Due West, SC 29639.

One of the latest problems developing in livestock agriculture today is the emergence of antibiotic resistant bacteria. This project studies whether the low levels of antibiotics used in chicken feed promote the emergence of these strains in commercial chickens.

To test my hypothesis that chickens fed low levels of antibiotics will contain more resistant strains than chickens not fed antibiotics, feces samples were taken from three populations of chickens, one of which was fed low levels of neomycin and oxytetracycline. Series dilutions were performed and the samples plated. The samples were tested for antibiotic resistance to neomycin and oxytetracycline. Antibiotic disk plates were made to test dual resistance, resistance to various concentrations, and to compare rings of inhibition with those of commercially sold E. coli.

It was determined that large amounts of resistant strains were significant in antibiotic fed chickens as compared to non-antibiotic fed chickens (determined by a chi square). Dual resistance and resistance to concentrations ten times the original plate concentration were present. There were also major differences in the size of inhibition rings in the compared disk plates. Dual resistance to antibiotics and resistance of bacteria other than E. coli led to the conclusion that conjugation had occurred and resistance was R-factor mediated.

The project also raises questions concerning the consumption of products which contain these resistant bacteria and the possible effects on the human system.

#First Award - American Medical Association
Fourth Award - General Motors ISEF

ANALYZING B-VITAMIN INFLUENCE ON THE BACTERIACIDAL ACTION OF AMINOGLYCOSIDE ANTIBIOTICS

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The main goal of this research project is to determine how B-vitamins would influence the bacteriacidal action of the Aminoglycoside antibiotics. I deem it important to know what substances if any, may or may not be detramental to the bacteriacidal action of an antibiotic since infection control and cure depend upon them. Since these antibiotics exert their bacteriacidal action by interfering with the biosynthesis of proteins and vitamins in prokariotes, I am assuming that introducing B-vitamins to a bacterial culture will induce a resistance to these antibiotics.

I first chose an orgainsm that could absorb outside nutrients, E. Coli strain W-0136. Then I prepared a minimal synthetic growth medium in which the cultures were to be established. Next I prepared 42 agar plates, 7 for each of 6 B-vitamins used, each one having one of 7 increasing vitamin concentrations from 15.13 mcgs to 1000 mcgs per plate. The vitamins were prepared as stocks at 15 mg/1 ml H_2O and sterilized. Next, I innoculated the plates with the E. Coli, applied the antibiotic disks, and incubated them for 4 days.

I observed that for each vitamin, there was a trend of increasing resistance among each of the antibiotics in E. Coli, as the vitamin concentration increased in the culture medium. I concluded that the B-vitamins were apparently responsible for inducing a resistance in E. Coli to the antibiotics.

This research could be used and further developed to see if B Complex could detramentally affect antibiotics in humans in the treatment of infection. Better understanding would be gained by knowing what factors make antibiotics less effective in treating and curing infection.

#HERBICIDES EFFECT ON R. JAPONICUM

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The hypothesis was to determine if herbicides affected the development of nitrogen-fixing soil bacteria when applied at manufacturers' recommendations. This is a three-year study.

Herbicides control the growth of unwanted grass and broadleaf weeds. R. japonicum is an important soil bacterium which lives symbiotically in nodules only on Glycine max, soybeans, and fixes nitrogen in a usable form for plant use. The soil nutrient balance and pH was tested. No herbicide carry-over existed in the Fayette soil used. Field and laboratory tests were done to confirm the absence of R. japonicum in the soil flora. Hodgson 78 brand seeds were inoculated with known R. japonicum and planted in five test plots. Four herbicides, recommended for soybeans, were diluted and applied to field test plots prior to emergence. Stem growth and precipitation were measured during a five-week growth period. Fifty plants from each plot were dug and the nodules carefully removed. The nodules were dried, counted, measured, and weighed. In the laboratory, control nodules were sterilized, crushed, and cultivated in a mannitol-phosphate broth. Five serial pour plate dilusions were made from each loopful of broth. Each mannitol-phosphate agar plate contained a herbicide diluted to the manufacturers' recommendations for the area of the petri dish. Incubation period was 24 hours at 70°F. Surface and subsurface colonies were counted..

Field and lab tests showed that herbicides had pronounced some effects on the development on R. japonicum in which the nodules showed a decrease, especially for a particular herbicide. Herbicides should be used only when needed and be applied as recommended.

#Fourth Award - General Motors ISEF

PLASMID-MEDIATED RESISTANCE TO THE METABOLIC EFFECTS OF LEAD CONTAMINATION

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Ever since the Industrial Revolution, the concentration of lead in the environment has increased to enormous amounts. With the birth of the automobile, the amount of lead deposited in the roadside environment is staggering. For this reason, the purpose of this project is to investigate this problem. First, two samples of sediment from a roadside pond was analyzed by X-ray flourescence analysis and found to contain 52.96 mg/l Pb. Next, the effect of this along with other concentrations of lead nitrate on bacteria was studied by observing the effects of 0, 5, 50, and 250 mg/l lead nitrate on the oxygen consumption rate of E. coli. The average consumption rate in the presence of 0 mg/l Pb was 76.1 mg/l/hr O_2; with 5 mg/l it was 47.3; with 50 mg/l it was 30.9; with 250 mg/l it was 21.6. It was also observed that the pH of the solutions containing lead turned acidic in ½ the amount of time it required the control. These results could show the possible switch of E. coli from aerobic to anaerobic respiration.

After observing what toxic effect lead had on laboratory bacteria, the next step was to determine how the bacteria in the pond are able to survive in such a toxic environment. 32 bacterial isolates from the pond which grew on 200 mg/l Pb plates were screened for the presence of a plasmid. One strain which was found to contain a plasmid was cured of it by an acridine orange treatment. In the absence of the plasmid, the bacteria were unable to grow on 200 mg/l Pb plates. The plasmid was then transfered to another bacterial strain of a different genus. With the plasmid, the bacteria were able to grow in the presence of lead, whereas before they couldn't. This shows that the plasmid does enable the bacteria to grow in lead.

#First Award - General Motors ISEF

First Award - U.S. Department of Energy

PHYSICS

AN INVESTIGATION OF THE BEHAVIOR OF A VISCOELASTIC FLUID

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What is a viscoelastic fluid? To answer this question three simple experiments were done to investigate the behavior of the viscoelastic fluid, polyethylene oxide.

First, the appearance of a drop of polyethylene oxide was observed. It was found to form a smaller drop than water and was more spherical than water. After sitting the drop pulled together to form a lense.

The second experiment looks at the capillary action of this viscoelastic fluid. Tubes with varying diameters were placed in the fluid and the fluid heights were compared to that of water. The capillary action was the same as water.

The last experiment examined the ability of the viscoelastic fluid to siphon itself out of a container.

Hypothesis: The heavier polymer would continue to flow out of its container for a longer time after the container is placed upright.

Result: The solution did continue to siphon with a gradually thinning stream. Then it stopped.

"MAY THE FORCE BE WITH YOU; HOW DO MECHANICAL PROSTHESES STIMULATE HUMAN WALKING"

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The purpose of this project was to compare the motion of mechanical prostheses and human walking, determine how close the imitation is, and investigate how the differences between human walking and prosthetic swing could be minimized.

A reference base of human walking motion was established by conducting a study of the various arms, levers, and Class I and III fulcrums of the hip and ankle. The forces in the upper and lower legs and the ankle were identified and the resultant torques were described theoretically.

Experiments were performed observing, measuring, and calculating lengths and angles in the human gait using a human male and a human female subject. Subsequently, a hip-disarticulation prosthesis was used in a series of two hundred trials to determine the "ideal" adjustment of the prosthetic limb.

The results of these two experiments were compared. Although the mechanical prosthesis approached the efficiency level of the human leg, nature provides in the human leg, a coefficient of friction, speed and smoothness, still unrivaled by present technology. The results of my experiment, however, may lead to advances in narrowing and eventually removing the discrepancies between human and mechanical walking. By considering the measurements of force and weight distribution which I investigated and described, prostheses can be made more comfortable for the patients and may be made more efficient, by more closely simulating the "perfection" of human walking.

THE DOPPLER EFFECT / DEMONSTRATING THE DOPPLER EFFECT IN WATER

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The scientific principle of the Doppler Effect is used in many areas of our everyday life: radar navigation, air traffic control, air defense systems, satellite communications, weather forecasting, medical diagnosis, and astronomy.

The objective of this project is to demonstrate the Doppler Effect in a tank of water by using a wave generator and a sensor probe moving along the top of the waves. As the sensor probe moves toward the source of the waves, the frequency of contact between the probe and the water should be increased; as the probe moves away from the source, the frequency should be decreased. The results substantiate the hypothesis.

The water is contained in a long, slender, Plexiglas tank. The waves are generated by a paddle powered by a solenoid and timing device. The frequency of contact between the probe and the water is measured both by a digital read-out counter and by a timing device which flashes a light emitting diode each time the water contacts the probe. By comparing the flashing rates of the LEDs and the digital counter, the Doppler Effect is shown.

Several problems were encountered: rebounding waves, surface adhesion of the water to the probe, and standing wave patterns. The value of the system is that it could be used to study further these problems which could occur and be a problem in any body of moving liquid.

Because this project demonstrates in an easily understood manner a concept which in reality is quite complex, it is also ideal for teaching and understanding the basic principle of the Doppler Effect itself.

BYE-BYE BERNOULLI; THE REAL REASON AIRPLANES FLY

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Many pilots and college physics students are taught that the reason an airplane or a wing (airfoil) produces lift is an application of Bernoulli's Principle. This year's science fair project is designed to prove that there is another more significant explanation for how an airfoil produces lift.

The procedure involves two experiments. The first, a smoke tunnel experiment, shows how air flows over two shapes (airfoils) designed from the wings of aircraft in commercial aviation. The second experiment involves a wind tunnel and tests if each shape will fly and is designed so that the lift produced is measurable. In each experiment wind speed (air speed) is constant and the angle of attack (angle of the front of the airfoil to the oncoming wind) is varied and the effects recorded.

The smoke tunnel data shows that as the angle of attack increased the angle of downwash increased. The wind tunnel shows that as angle of attack is increased the lift produced will increase.

This then proves the relationship between lift produced and downwash and that downwash must be a major contributor to how a wing creates lift.

For those people who thought that Bernoulli's Principle was the only factor involved in why airplanes fly, I hope I have offered another explanation that is even more acceptable. I also hope that this project being on display has made the community more aware of aerospace and The Real Reason Airplanes Fly.

DETERMINING THE AERODYNAMIC QUALITIES OF FORWARD-SWEPT WINGS AND CANARDS

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PURPOSE: (1) to design and build a windtunnel so that I may (2) determine the aerodynamic qualities of forward-swept wings and canards.

PROCEDURES: I designed and constructed a windtunnel that is composed of 3 sections: a motor housing, a compression chamber with a grid, and a testing chamber. The grid straightens the air as it passes through to the testing chamber. I also installed a mounting system so that the models of airplanes could be moved into various configurations. The walls of the testing section were made of plexiglass. 3 airplane models were constructed: a control with aft-swept wings, FSW-T with forward-swept wings and a tail, and FSW-C with forward-swept wings and a canard. Each model was subjected to simulated takeoff, cruise, maneuver, and landing conditions in the windtunnel.

RESULTS: During TAKEOFF, the control formed tip vortices and had extreme wash-out. FSW-T had extreme wash-in. FSW-C had moderate wash-in. During CRUISE, the control showed a small amount of wash-out. FSW-T had extreme wash-in and some tip vortex formation. FSW-C had moderate wash-in. During MANEUVER, the control formed tip vortices and had wash-out. FSW-T had extreme wash-in. FSW-C had moderate wash-in near the fuselage. Both the control and FSW-T stalled on both wings. During LANDING, the control stalled and formed tip vortices. FSW-T had extreme wash-in and stall near the fuselage. FSW-C had light wash-in and stall near the fuselage.

CONCLUSIONS: Forward-swept wings reduce tip vortex formation. Canards reduce stall near the fuselage. FSW-C is most efficient during TAKEOFF, MANEUVER, AND LANDING while the aft-swept control is best during cruise. Forward-swept wings have wash-in instead of wash-out as in aft-swept models.

FIN CANTING: A NOVEL METHOD OF ROCKET STABILIZATION

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Rockets are presently stabilized by one of two methods. The first method uses fins attached to the anterior portion of a rocket which protrude into the surrounding airflow creating a moment tending to restore the rocket to its original orientation when the rocket yaws from its ideal trajectory. The second method makes use of a rapid spin about the longitudinal axis which not only creates stabilizing gyroscopic effects, but also causes dispersion inducing forces such as thrust malalignment to act in one direction and then another, much reducing their effects.

It is the purpose of this project to determine the effects of fin canting on the trajectory. Canted fins are those whose surfaces are equally oblique with the surrounding airflow. This method will provide the rocket with both a restoring moment and spin about its longitudinal axis. First the forces introduced by fin canting were analyzed theoretically and approximate values for the dispersion of rockets to be launched was calculated based on the assumption that characteristic functions for fin stabilized rockets would hold for rockets with canted fins.

Ten rockets with varying fin cant angles were then prepared and launched. The experimental values for the ranges and dispersions of the rockets were evaluated and compared with the theoretical values. The data confirmed that present methods of predicting range can be applied to rockets with canted fins. The data also confirmed that fin canting does reduce dispersion, but standard ballistics equations cannot be used to predict dispersion.

The next goal of this project is to empirically establish characteristic functions for rockets with canted fins; accurate determination of trajectories should then be possible.

#Second Award - National Aeronautics and Space Administration

#EXPERIMENTAL VARIATIONS AFFECTING THE MOLECULAR CONDUCTIVITY OF A PHOTOVOLTAIC UNIT

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One of the greatest drawbacks to widespread use of photovoltaics is the cost. A high cost is incurred first when a system is initiated and again when it comes to maintenance. The purpose of this project was to determine what steps could be taken to better utilize the output potential of a photovoltaic unit, thus allowing the consumer to get a greater return from his investment more quickly than at present.

Testing and research were done in each of the following areas to determine the roles that these varying experimental conditions play in the output of a photovoltaic unit: 1) varying wavelengths of light, 2) angle of incidence of light striking the unit, 3) temperature fluctuations, 4) varying mediums of unit placement, and 5) index of refraction of mediums of unit placement. Experimentation was also done to determine whether or not a photovoltaic unit could be used for industrial purposes as a depth finder for clear liquids.

After three years of research, I have determined that the following properties improve the output of a photovoltaic unit: 1) longer wavelengths of light, 2) light rays striking the unit at a 90° angle, 3) higher temperatures, and 4) liquid mediums of unit placement. The index of refraction of mediums of unit placement seemed to have no effect. It was also determined that a photovoltaic unit could be used to determine the depth of some clear industrial liquids.

#Second Award - American Association of Physics Teachers
Fourth Award - General Motors ISEF

HEAT FROM DIFFERENT TYPES OF WOOD

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Purpose: Since wood has always been, and still is, a major source of heat, I decided to find out which wood was the best heat source. I determined from experiments how much heat is in different types of wood.

Procedures: 1) Build a calorimeter with a 6oz. juice can and a 13oz. coffee can and 2 square feet of fiberglass insulation. Also, build an insulated burner with the same materials, but add a hole and insert a metal tube so the fire can receive oxygen.

2) Measure out an amount of water in the calorimeter. Measure out a sample of wood and place it in the burner. Record the mass of the wood in grams.

3) Record the temperature of the water in the calorimeter. The temperature should be recorded in Celsius degrees.

4) Place calorimeter on top of burner. Light the wood in burner. Record time wood starts burning. When wood stops burning, record time and temperature of water.

After the actual experiment, use the definition of a calorie to figure the calorie output of each wood. The calorie is defined as the quantity of heat needed to raise the temperature of one gram of water one Celsius degree.

Conclusion: Soft wood, such as populars and pines, produce a lot of heat over a short period of time. Hard woods, such as oaks, produce more heat than soft woods, but it takes hard woods a longer time to burn.

MEASURING DISTANCE WITH LIGHT WAVES

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This project determined whether measuring small distances using the properties of light was an accurate and feasible method. By placing two flat glass plates together and separating one edge by a thin substance, a wedge-shaped air pocket is formed. When monochromatic light shines upon the plates from above, bands appear. Light reflected from the upper surface of the lower plate is shifted in phase by half a wavelength whereas light reflected by the lower surface of the upper plate is not. As a result, destructive interference occurs, and dark bands are seen at certain intervals upon the plate. Because the angle created between the plates is directly related to the thickness of the sample, the number of bands per unit distance can be established.

By designating sample 1 (of known thickness) to be the experimental constant, sufficient data was established to obtain a relationship between the angle of the plates and the number of bands. Graphing the data created a linear relationship. Then, by referring to the established relationship of angle vs number of bands, the thickness of the unknown samples was obtained. Next, an alternate method of obtaining the thickness of the unknown samples was used (calculation by determination of mass, area, and density) to verify the accuracy of the first experiment. The separate calculations were compared, and results were fairly accurate. It was concluded that measuring distances using light waves was a feasible method.

#VARIATION OF THE SPEED OF SOUND WITH TEMPERATURE AND HUMIDITY

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An experiment was developed to determine how temperature and humidity affect the speed of sound in air. A starter pistol was used to generate a sound which was then reflected off of a brick building. The distance from the sound source to the building was 300 feet. The starter pistol was fired five or six times and the gunshot and echo were recorded on a cassette recorder. The temperature and relative humidity at the time of the experiment were also recorded. This process was repeated on nine different days. A computer program was written to receive the signals from the gunshot or echo every .02 seconds and display these signals using a computer printer. The data was then analyzed, the time from gunshot to echo determined, and the speed of sound was calculated. The speed of sound was plotted on two graphs: one as a function of temperature at 100% relative humidity and the other as a function of humidity. The speed of sound for the second graph was adjusted to a common temperature using the slope of the first graph.

The results of this experiment show that the speed of sound increases at a constant rate with both temperature and relative humidity. For temperature, a change of 2.05 ft/sec was observed for each degree celsius change. For relative humidity, a change of .25 ft/sec was observed for each percent change in relative humidity. The total error for this experiment was less than .5%.

#Second Award - Acoustical Society of America

TOPSPIN AND FUZZ

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The purpose of the project was to determine how the amount of fuzz on the surface o f a tennis ball affects the pressures located around the middle of a tennis ball hit with a type of tennis stroke known as the topspin drive (top-over-bottom rotation). The topspin flights of four tennis balls, each with varying amounts of fuzz on their surface, were simulated in a wind tunnel. To simulate the top-over-bottom rotation of the balls, the balls were attached to a motor which rotated at 3300 rpm. To test the pressures located around the middle of the balls, a "U" tube manometer was used. Three different tests were performed on the balls. The first test measured the pressures around a simulated topspin ball. The second test measured the pressures around a rotating ball. The third test measured the pressures around a non-rotating ball. With the completion of the tests the following results were produced. In the first test the ball with the most fuzz had the greatest pressures and the ball with the least fuzz had the least pressures. In the second test the balls all had the same pressure patterns. In the third test the ball with the most fuzz had the greatest pressures and the ball with the smallest diameter had the least pressures. From the above results the following conclusion was produced; The more fuzz there is on the surface of a tennis ball the greater the pressures will be on the surface of a tennis ball.

#THE EFFECTS OF TRIETHANOLOMINE CONCENTRATIONS ON THE COLOR OF HOLOGRAMS

de Villiers, Clare, Oregon Episcopal School, Portland, Or. 97223
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It can be hypothesized that a preswelling procedure spreads the gelatin fringes in holographic emulsion so that after exposure a hologram would reflect light at a different wave-length than that with which it was produced. This project proposed to determine the correspondences between a concentration of triethanolomine preswelling solution and the dominant color that results in a reflection hologram.

Holograms were soaked in various concentrations of triethanolomine for 5 minutes and then exposed to a red neon/helium laser. The following triethanolomine concentrations and the colors produced by them are representative of the color range possible: red-0%, orange - 5%, yellow - 7%, green - 15%, blue - 23%, violet - 25%. As the percentage of triethanolomine is increased, the developed hologram reflects light at smaller wave-lengths.

#First Award - Optical Society of America

WATER FLOATS

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This project explores and attempts to explain a phenomenon in which droplets of water float on the surface of a main body of water. The formation of these drops seems dependant on three factors: 1) the height from which drops fall, 2) the surface viscosity of the water, and 3) the cleanliness of the surface of the water. In the beginning, the research was done with a syringe. Later, an oscillator was added to prolong the life of the drops and the syringe was replaced by the plastic and metal tubings that are on the display. The addition of soap to the water increased the number of floating drops that formed. Since soap decreases surface tension, this proves that drops are not supported by surface tension alone. It is my belief that the drops are supported by a pocket of air trapped between the drop and the bulk liquid. This pocket is wide in the middle and narrow along the edges. The air slowly escapes through the narrow gap along the edges of the drop. Eventually, the air pocket becomes so thin that the weight of the drop ruptures it and the drop coalesces into the bulk liquid.

#USE OF OPTICAL CAUSTICS AS IDENTIFYING AGENTS FOR POLYMERS AND CRYSTALS

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Previously defined as the "envelope of rays emanating from a point reflected or refracted by a curved surface," optical caustics form the basis of this two-year study. The curves are formed when a type of coherent light (such as a laser) is projected through an uneven surface.

After discovering that the formations were unique to polymers such as gelatin, rubber cement, and polyurethane, the researcher began studying the patterns produced when the laser was directed through varying crystal formations. Unique findings were made showing that caustics show promise as indicators for the seven basic crystal systems (monoclinic, orthorhombic, etc.). Further investigations were conducted and conclusions were drawn.

#Second Award - Society of Photographic Scientists and Engineers

AMOUNT OF VOLTAGE NEEDED TO REALIGN THE MOLECULES OF LIQUID CRYSTAL
BO-TN-100

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A regular nematic liquid crystal is a transition phase that occurs when a chemical is heated to melt it into a liquid. The molecules are aligned parallel to each other in groups called domains. These domains are randomly oriented in any direction. Nematic liquid crystal molecules can be reoriented by electricity, or by a magnetic field.

To observe the effect of the field, all the domains had to be aligned in one direction between two glass slides with conductive coatings before voltage was applied. To determine how the distance separating the conductive coating affects the strength of the electric field that is needed to realign the domains, several samples of liquid crytals were made. Each sample used a different sized spacer. Four spacers were used--36.1 μm, 76.2 μm, 152.4 μm, and 288.6 μm. The electric field was applied and a laser and crossed polarizers were used to make the effect of the field observable.

The larger the spacing, the less voltage that was needed to re-orient the domains. As the spacing got larger and larger, the additional domains for each spacing had gradually less effect on the contrast in orientation produced by the electric field. The rate of the decrease in the needed field strength slowed down. The electric field needed to realign the molecules should not go down to zero because the molecules on and near the sample walls are tightly held by the surface.

COMPUTERIZED RECOGNITION OF SPEECH UTILIZING AN ACOUSTO-LASER OF ORIGINAL DESIGN

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The purpose of my research was the development of a system of computerized recognition of speech using the Commodore 64 home computer. My approach to this goal has been to recognize phonetically derived optical patterns. The pattern-providing, acousto-laser interface utilizes a poly(vinyl chloride) membrane which vibrates when the pressure changes of sound strike it. By vibrating, the membrane generates angular change in the reflection of a laser beam and thus creates patterns. The resulting ellipsoidal patterns are known as Lissajous figures. I have found that they are unique to the acoustical spectra with corresponding sympathetically resonant stress areas in the membrane's overall stress configuration. To enable the computer to examine critical portions of the patterns, I developed an array of photodetectors. The patterns are displayed on the array which detects critical points of intersection and stores them for future comparison. The computer program which I have written for the system rates the comparison of data and gives a high rating of recognition to one word from its initial vocabulary of command words (list, load, new, run, and save).

#First Award - Allegheny International
Scholarship - Ohio State University
Second Award - Ball Electronic Systems Division
Second Award - General Motors ISEF
Second Award - United States Army

The Organic-dye laser and It's Tuneable Characteristics

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It has been discovered that some organic dyes can be induced to emit coherent laser light. The new and exciting characteristic of these lasers is that they can be tuned by a number of methods. The methos of tuning studied is that of changing the concentration of the dye molecules in an alcohol solution used as the lasing medium. It has been found that the wavelength of the output beam increases when the concentration of the dye increases. It is desired to know what wavelengths of laser light are emitted by various concentrations. Using a statistical method the dye to alcohol proportions for various wavelengths of output beams is deduced from experimental data.

#First Award - Vacuum Technology Division of the American Vacuum Society
Honorable Mention - Optical Society of America

THE COSMIC RADIATION SPECTRUM

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The goal of my project is to determine a low energy spectrum of cosmic radiation. To find this, I placed a diffusion cloud chamber in a magnetic field of 1000 gauss and then took pictures of the cosmic events which occurred. The magnetic field caused a curvature of the paths which I used to determine the energy of the particles.

The diffusion cloud chamber causes the trails of ionizing cosmic radiation to become visible through the condensation of alcohol vapor. When the cloud chamber is placed in a uniform magnetic field, the charged particles curve according to their charges, masses, and velocities. The particles of lesser charge, higher mass, and greater velocity curve the least. This curvature can be used to find the energy of the particle when the strength of the magnetic field is known using the formula, 300 Br = Eev/z where

B = the strength of the magnetic field in gauss,
r = the radius of curvature in cm,
Eev = the energy of the particle in electrovolts, and
z = the elementary charge of the particle

The number z could be determined if individual ion pairs were distinguishable in the photographs. Because I was unable to do that, my energy determinations are given in Eev/z.

Using these methods, I collected and analyzed more than 60 photographs to assemble a low energy cosmic radiation spectrum (a stronger magnetic field would allow higher energy determinations). I hope to devise not only this energy spectrum, but also a chart of charge and mass distributions using slightly modified techniques.

#Honorable Mention - Society of Photographic Scientists and Engineers
Honorable Mention - Eastman Kodak Company

WINDMILL DESIGN AND OPERATION

Milliken, Christopher E., Davis H.S., Kaysville, Utah 84037;
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A windmill is an aerodynamic device used to harness the kinetic energy of the air. With this in mind, I set out to build several windmills, to determine which one was the most efficient, and to find new ways to improve existing windmills. I used both tip vanes and shrouds to improve efficiency.

To prove my ideas, I built four windmills; three horizontally mounted with two, three, and four blades respectively as well as one vertically mounted turbine. Each was made by gluing .7 cm. balsa strips together then sanding them with a fine grade sandpaper to the proper dimensions. I then tested each in a homemade wind tunnel for voltage and amperage output at several speeds and recorded my results. To these windmills, I added tip vanes and shrouds and again tested them.

I found overall that theoretically and in actual testing a two bladed windmill is twice as efficient as any other mill tested. The three bladed mill was second with the four bladed close behind which indicates a correlation between the number of blades and their efficiency. This is found to be caused by the fact that it is the area of the disk swept out by the blades that determines energy output.

Both tip vanes and shrouds also proved effective. The tip vanes increased the windmillpreformance by 25% at low speeds but actually reduced preformance by 10% at higer speeds. The shrouds provided a uniform energy increase of 15% at all speeds.

#POINT AND EXTENDED SOURCE DETERMINATION USING RADIOMETRY AND INTERFEROMETRY

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PURPOSE: To determine the sources of noise in radio communications equipment and ascertain its nature and mechanism.

PROCEDURE: Construct a radiometer consisting of antenna, receiver, recording device and an interferometer consisting of two antennae, preamplifier, receiver, square law detector, op-amp and recording device for the purpose of detecting, recording, and explaining radio noise sources, their origins, character, frequencies and the mechanisms responsible for their creation.

MATERIALS: Common lumber, window screen wire, P.V.C. pipe and fittings, copper tubing, rain gutter down spout, coaxial cable, coax fittings, communications equipment, receivers, preamps, chart recorder, transmitter.

DATA: Consists of Electrical appliance noise patterns, solar flare observations (S.E.A.), Leonid Meteor shower, Test data from the extended source, and **MERIDIAN TRANSIT OF CYGNUS A** radio source.

CONCLUSIONS: Thermal Activity produces broadband radio noise. Emission of Light is accompanied by Radio noise. Most Radio Noise can be explained in terms of Electron excitation. CYGNUS A is either very far away or very small. CYGNUS A subtends an angle less than 1.0 x 10 -16 degrees and has an experimentally determined strength of 8100 flux units.

REFLECTIONS AND APPLICATIONS: Radiometry yields an indication of the gross process and dimension of Electromagnetic Radiation. It is useful to determine the macroscopic levels of radiation affecting communications and radiation doses present. Interferometry has been used to measure distances to an object, distances between the two "slits" (antennae), and precise wavelength of a radio emission. Also Cosmology and possibly Schwarzchild radius theory confirmation.

#Fourth Award - General Motors ISEF

#DOES RAMP CONFIGURATION INFLUENCE ACCELERATION?

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DOES RAMP CONFIGURATION INFLUENCE ACCELERATION? TO ANSWER THIS QUESTION, I CONSTRUCTED TWO RAMPS OF DIFFERENT CONFIGURATIONS, RAMP A, WAS IN A STRAIGHT-LINE AND RAMP B, DESCENDED IN A HELIX. A SPHERE WAS ROLLED DOWN EACH RAMP AND THE ELAPSED TIME RECORDED. AFTER TEN TRIALS FOR EACH RAMP, IT WAS DETERMINED THAT THE HELIXICAL RAMP PRODUCED LESS ACCELERATION THAN THE STRAIGHT-LINE RAMP. BECAUSE THE HEIGHT OF THE RAMPS AND WEIGHT OF THE SPHERE WERE THE SAME FOR BOTH RAMPS, THE POTENTIAL ENERGY WAS EQUAL. HOWEVER, WHEN THE POTENTIAL ENERGY WAS CONVERTED TO KINETIC ENERGY, THE HELIXICAL RAMP USED A GREATER AMOUNT OF ENERGY TO KEEP THE SPHERE TRAVELLING IN A HELIX. THIS MEANT THAT LESS ENERGY WAS AVAILABLE TO ACCELERATE THE SPHERE DOWNWARD. THUS, THE STRAIGHT-LINE RAMP PRODUCED A GREATER ACCELERATION THAN THE HELIXICAL RAMP. AFTER COMPARING THE MEASURED RESULTS WITH THE THEORETICAL RESULTS, THE % OF ERROR WAS FOUND TO BE VERY SMALL. THE HELIXICAL RAMP PRODUCED ELAPSED TIMES 31% LONGER THAN THE STRAIGHT-LINE RAMP.

#Third Award - General Motors ISEF

WHAT LOAD IS BEST FOR THE 7 MAGNUM RIFLE?

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The aim of the project was to find out what kind of load would provide the best penetration and accuracy, in a 7 magnum rifle. A 145-grain Boat-tail bullet was used. These bullets were chosen because they are good for deer-hunting and target-shooting.

It was expected that the medium load would penetrate the deepest and provide the greatest amount of mushrooming of the bullet. Also, there would be less change in the elevation from the aiming point.

A cardboard box was packed with telephone books and targets were stapled to the front. Three bullets, each with different powder-loads, were shot at the target from a distance of 250 yards, using a bench-rest position. The first load tested was with 59.0 grains of IMR-4831 powder. The average bullet penetration was 16.8 cm into the target, and mushroomed from .284mm to .719mm in diameter. These penetrated an average of 18.5 cm into the target and the diameter mushroomed .284mm to .890mm. These 3 bullets showed zero elevation, and the medium load was 61.0 grains. The maximum load used was 63.0 grains.

The average penetration on those was 19.4 cm, and mushroomed from .284mm to .960mm. These 3 bullets rose in elevation on the average of 5 cm.

The result differed from my original hypothesis as the bullet with the highest powder-load proved to have the best depth of penetration and the greatest amount of mushrooming which would have the greatest effect. The problem of bullets rising in elevation from the aiming point would need to be dealt with.

The result of this project is that 63.0 grains of powder is best for the 7 magnum.

#USING A PENDULUM AS AN EXTREMELY PRECISE ACCELEROMETER

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This project determines acceleration due to gravity using a pendulum. The period of the pendulum is timed using an electric eye and an Apple computer. The electric eye was chosen after several tests were run to find how different eyes react to the pendulum. Those tested included cadmium sulfide cells, photo-transistors, LED's, and light bulbs. Pendulums of different masses were then tested to determine what the design and mass of the final pendulum would be. The pendulum was then constructed and tested. A very fast timing program was written that was accurate to .000 011 seconds. This was tested to find the deviation when the pendulum was at one location. This indicated accuracy to $\pm.007$ m/s^2 or $\pm.000\ 7$ times the acceleration due to gravity.

#First Award - Society of Exploration Geophysicists
Fourth Award - General Motors ISEF

SLIPPERY SUBMARINES

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Turbulence in the boundary layer of submarines causes drag which inhibits the speed. If the drag of submarines could be reduced by certain hull shapes and/or coatings, submarines would be capable of travelling at greater speeds. In this experiment, various submarine shapes and coatings were tested in order to determine which combination is most conducive to increasing the speed. Methyl cellulose and hot water were used as coatings to decrease turbulence. Of the various submarine shapes and surfactant coatings, a single combination of all three produced the least amount of turbulence.

SPIRAL GALACTIC STRUCTURE

Bies, William E.,Mt. Lebanon H.S.,Pittsburgh, Pa. 15228;
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The occurrence of spiral structure in galaxies is puzzling to astronomers. This investigation concerns the model of self-propagating star formation, which proposes that chains of star formation are sheared by differential rotation into spiral features. For this investigation, the model was programmed on a computer, and it was hypothesized that spiral features would be generated. After determining appropriate values for certain parameters, the program was tried with different galactic rotation curves and for extended periods of time.

The results show that good spiral galaxies appear almost immediately and last indefinitely. Additionally, the model galaxies correspond well to actual galaxies. The program was run on a personal computer, and its success indicates a heretofore neglected usefulness of such computers.

#First Award - United States Navy/Office of Naval Research
Third Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

THE CORRELATION BETWEEN THE PROPERTIES OF LASER SPECKLE PATTERNS AND MODAL NOISE IN MULTIMODE OPTICAL FIBERS

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With a sufficiently narrow source spectrum, and either fiber movement or source frequency shift, a changing speckle pattern exists at the output plane of a multimode fiber resulting in signal power fluctuations known as "modal noise". There is considerable interest at present in the reduction of the apparent fluctuation associated with the modal noise. This project was undertaken to demonstrate the noise amplitude dependence upon fiber numerical aperture.

The relationships were tested employing two graded-index optical fibers with NAs of 0.24 and 0.29. The fiber core and cladding diameters were 50μm and 125μm, respectively. A 8mW single frequency HeNe laser illuminated these silica (SiO_2) fibers, the output end of which was imaged onto a Silicon detector. These fibers were moved and the output was displayed on an oscilloscope face.

The concluding experiments determined that modal noise amplitude decreases with increasing fiber numerical aperture. The amount of power fluctuation shown on the oscilloscope was reported to be less for the higher NA fiber and consequently, greater for the lower NA fiber. A knowledge of the modal noise amplitude is of importance because it is beneficial in reducing the apparent fluctuation associated with the modal noise, thus enhancing the performance of lightwave systems.

BINARY STUDY ON THE RECOVERING OF REJECTED MATERIAL USED CERAMIC CAPACITORS.

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XVII - TALENT SEARCH - IBECC - SÃO PAULO - BRAZIL

After producing dieletric material ($BaTiO_3$ plus dopants), used in the manufacturing ceramic capacitors, considerable amount of material rejected. This work is an effort to find out a may to recover the conditions of utilization of this material. Eleven samples of ceramic substance were producing starting with material which satisfied the standard specifications.

The ten remaining samples contained amounts of the refused material, differing in 10% one from another.

In order to stablish a judgement about the avality of the samples, the different dieletric properties were chosen as parameters.

It was concluded that the dumped reutilization of the refused material was perfectly acceptable to 100%, for the producting of type II capacitors and below 30% for the type III capacitors.

#QUARK-LEPTON SUBSTRUCTURAL CONSTRAINTS

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Chicago, Il. 60636.

The purpose of this research project was to establish whether or not there exists a pattern to quark and lepton masses, and if a pattern exists, what information can be gained from this pattern which could be used to develop a model of quark and lepton substructure.

This was done by plotting the log of the masses of the quarks and leptons on a graph. The masses of the quarks were based on various electromagnetic and SU(3) mass splitting of mesons and baryons, and the masses of the leptons were based on direct experiment.

It was found that quarks and leptons do exhibit a pattern of mass, and this pattern was used to extrapolate to a fourth generation. It was also found that if quarks and leptons are composite, the sub-particles of the 2/3 charged quarks and the charged leptons must be similarly arranged. Thus adding a guideline which can be used in developing a model of quark and lepton substructure.

#Third Award - American Association of Physics Teachers
Alternate to Scholarship - Ohio State University

#MODELING QUADRUPOLAR OSCILLATIONS FOR A TRIANGULAR LATTICE

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The molecular ordering of non-crystalline solids is not understood quantitatively. Spin glass phases are a method of describing this molecular ordering. The spin glass phase is in between a long range magnetic order and a completely disordered phase. Currently solid hydrogen, the simplest solid, is being used to study spin glass phases. There are two distinct species of hydrogen: orthohydrogen and parahydrogen. Orthohydrogen, the hydrogen molecule responsible for the spin glass phases, is a quadrupole. A quadrupole is that which has four magnetic poles. Orthohydrogen molecules (quadrupoles) arrange in a certain energy configuration forming a spin glass phase. Once the quadrupoles are thrown out of their alignment, they oscillate at certain frequencies back to their original configuration. This research deals with finding these unknown frequencies. A model consisting of several quadrupoles was made. After the model was made, coils of wires were attached to it. As the quadrupoles oscillated back to their original configuration, a voltage was induced in these wires. The voltage was amplified and sent to a signal averager. The signal averager mathematically analyzed the signal, using a Fourier transformation. The challenge of this research was to model quadrupolar interaction. A model was made on an enlarged, workable scale. This model was successful enough to detect the fundamental modes of motion of the system (librons).

#Second Award - General Motors ISEF

RUTHERFORD'S ALPHA SCATTERING

Timmerman, Rudy J., Wickes H.S., Wickes, Ark. 71973;
Box 170-A, RR1, Wickes, Ark. 71973

The purpose of this project was to perform Rutherford's alpha scattering experiment using new techniques to detect and count the alpha particles. From this data it was intended to verify Rutherford's scattering formula.

Alpha particles, from a source in a smoke alarm, were allowed to pass through a piece of gold leaf. Alpha sensitive film, obtained from Dr. Leming of Henderson State University, was used to find the positions of the alpha particles after they passed through the leaf. The experimenter developed the film. The image on the film was projected onto a screen where the dots from the alpha particles were counted and their positions recorded. This was done by means of a pivoting bar with a slider across it which sent varying voltages to an interface, indicating the location. A computer program, using information gained through the interface, identified and graphed the locations of the dots on the film. The program and location bar were designed and made by the experimenter who also built the interface.

#First Award - American Association of Physics Teachers
First Award - General Motors ISEF
First Award - Vacuum Technology Division of the American Vacuum Society

HOW SINGLE-MODE, POLARIZATION-HOLDING FIBERS WOULD PERFORM IN SPACE

Davis, Michael A., Fort Hunt H.S., Alexandria, VA 22308;
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The purpose of this experiment is to investigate how single-mode optical fibers will function under adverse conditions of outer space. Because of the high fidelity transmission of single-mode, polarization holding fibers, they will be crucial components in space systems.

Three types of polarization-holding fibers in low temperature conditions and in an irradiated environment were tested.

To test the low temperature effect on a fiber polarized light was injected into a fiber and a photo-detector recorded the amount of light passing through the fiber. The fiber was then cooled using liquid nitrogen. All three fibers indicated no thermal hysteresis with a minimum temperature of -196 C and all fibers also displayed linear variation of birefringence with decreased temperature.

To test the irradiation effect on the fibers primarily the same set-up was used, without the cooling apparatus. Periodically each fiber was irradiated up to 100,000 rads using a ^{60}Co source located at the bottom of a 3 meter pool. Each fiber demonstrated a great increase in attenuation as it was irradiated, with no recovery after a 24 hour rest period.

Since the fibers demonstrated linear variation of birefringence with decreased temperature, it would be an advantage to employ these fibers in a low temperature environment. However, since they also demonstrated a great increase in attenuation when irradiated they would not work well in a spacecraft.

#Second Award - National Aeronautics and Space Administration
Second Award - Optical Society of America
Alternate to Scholarship - Ohio State University
Fourth Award - General Motors ISEF

HEAT RECOVERY TO IMPROVE ENGINE EFFICIENCY

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Investigations of using exhaust gas heat to increase engine efficiency by improved fuel-air mixture vaporization were performed on a Briggs & Stratton nine cubic inch engine. Testing was done in three phases: stock engine evaluation; the engine with a heat transfer unit and no heat; the engine with inlet gasses heated in twenty five degree farenheit increments until engine would not run due to vapor lock. Engine output was measured by a prony brake dynamometer and converted to horsepower. Other engine measurements include inlet and exhaust gas temperature, manifold vacuum, specific fuel consumption, and carbon monoxide and hydrocarbons by gas chromatography. Brake mean effective pressure and thermal efficiency were calculated. The use of a heat transfer unit acting as a manifold was used to heat inlet gasses in an attempt to retain more available energy by increased flame propagation during combustion and improved mixture stratification during compression.

Although volumetric efficiency was lost during heated engine configurations, thermal efficiency improvements over stock engine occured at higher temperatures, accompanied by a decrease in specific fuel consumption, and an increase in cylinder head pressure.

This study supports the capability of using heat recovery as an effective means of improving engine efficiency when coupled with a low output centrifugal pump to maintain original inlet volume.

First Award - General Motors Corporation
First Award - U.S. Department of Energy
Second Award - United States Air Force
Third Award - General Motors ISEF

SPLASH DYNAMICS: CAN THEY BE USED TO STUDY AERODYNAMICS

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While watching the diving competition of the 1984 Summer Olympic Games, I noticed a correlation between the amount of splash a diver makes when he enters the water, and the streamline of his body. It appeared to be that the more aerodynamic the shape of the diver, the less splash he created. Based on these observations, the following two hypotheses were developed--"There is a direct correlation between splash and aerodynamic form," and "This correlation could be used to study aerodynamic form."

Testing for these hypotheses was done in three different manners. Automobile prototypes were used for the testing--the first was coded with blue the second with red. The first data showed a difference of three inches in the height of splash (the red being higher). The second showed almost three times more splash generated by the red prototype than the blue and the third also registered more splash created by the red prototype.

All three of these methods reinforced the initial hypotheses, as the red prototype was of inferior aerodynamic form than the blue prototype. This shows that there is a correlation between splash and aerodynamic form that could be used to study aerodynamics.

WHICH BOTTOM IS THE BEST

Thompson, Ron, Nitro High School, Nitro, W.Va. 25143
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The purpose was to determine which type of water ski, a flat bottom ski or a concave bottom ski, performs best in three different areas. A scale model was made of each type of ski and a test trough constructed with a scale speed of 23 mph. The skiis were tested in three areas; surface tension, friction and stability. In the surface tension test it took an average of 9.0 grams to lift the flat bottom ski from the water and 12.1 grams to lift the concave bottom ski from the water. In the friction test the flat bottom ski exerted an average of 8.9 grams and the concave bottom ski exerted 7.1 grams. In the stability test it took an average of 13.1 grams to tip the flat bottom ski on its edge and an average of 17.4 grams to tip the concave bottom ski. The conclusion is that the concave bottom ski performed better in all three tests. These results will help the public realize the difference in performance between a flat bottom ski and a concave bottom ski.

#First Award - United States Navy/David W. Taylor Naval Ship Research and Development Center
Alternate to Scholarship - Ohio State University

THE PHYSICS OF TWISTING AND SOMERSAULTING

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The intentions of this project are to prove that when performing twisting stunts, divers do not violate the laws of angular momentum conservation, and that it is not necessary for the diver to apply any torques before leaving the take-off surface. I am involved with a diving team and, upon finding several articles involving the impossibility of these stunts, decided to do more research and experimentation on the subject. In this project, I will attempt to explain some of the misconceptions about somersaults with twists and offer examples that prove these dives to be possible without breaking any laws of motion.

AMORPHOUS CARBON COATING FOR Si IN A PEC CELL

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Due to the high cost of P-n solar cells, scientists are turning to the photoelectrochemical (PEC) cell as a possible solution. One major problem with PEC cells, which causes the current to drop to 0 in 20 secs., is the oxide formation on the surface of the silicon as it reacts with the electrolyte. This research project was thus undertaken to coat the surface of the Si with a recently developed amorphous carbon (a-C:H) film. The result of this coating, which is chemically inert and diamond-like in nature, was the maintaining of the maximum initial current produced by a PEC cell using bare silicon but for more than 48 hours. Thus with this new coating, PEC cells could possibly replace P-N solar cells in the future for they are much more efficient and much more economic to mass produce.

#First Award - General Motors ISEF
First Award - United States Air Force

THE EFFECT OF TEMPERATURE CHANGE ON A BODY OF WATER

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470 North 600 East, Richfield, Utah 84701

The basis of this project is to see if it is more efficient to heat a house quickly with a hot fire, or slowly with a less intense heat source.

The experiment used hot and cold water and a glass model of a home. Hot water will circulate in cold water somewhat like hot air currents do in your home. When hot water was colored and entered the cold water, the currents that flowed throughout the model could be seen (the same way hot air currents flow through your home).

By controlling the temperature of the hot water, several conclusions were discovered:

1. The hotter the heat source, the faster and more efficiently a home can be heated. If a fire is burned slowly, all circulation is lost because the cold air has time to surround the warm air and entrap it.

2. Not only will the hot fire heat the house more quickly, it will also provide better heat conduction into the depths of rooms. With a hot fire the air will expand horizontally much faster and much more efficiently.

#ENERGY AND EFFICIENCY ANALYSIS OF SALTS WITHIN A SALT GRADIENT SOLAR POND (SGSP)

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The purpose of this project was to determine the optimum materials and construction parameters for use in a SGSP through analysis of heat capacity, gradient stability and economics. A 90 L., 90cm^2 surface area, solar pond was constructed and well insulated on all sides. A stable 25% brine layer, and non-convecting 23% to 1% layers were established. A fresh water surface layer was added to regulate evaporation. NaCl, $MgCl_2$ and $CaCl_2$ salts were tested. During each 10 day test cycle the temperature of the bottom brine layer was checked every 8 hours. Specific gravity of the 23% and 25% layers was measured at the start and end of the tests to detect gradient instability or convection. 250 watt infrared and ultraviolet sunlamps were used to simulate sunlight. The following maximum temperatures were recorded: NaCl 28.5^{o}C, $MgCl_2$ 24^{o}C, $CaCl_2$ 23.5^{o}C. Gradient instability was minimal in all tests. Specific gravity either increased or decreased slightly dependent on the respective salts showing a deposition or precipitation rather than convection. NaCl was found to be less that 25% as expensive as the other salts. Conclusions: all 3 salts kept their gradient zones well; NaCl had the highest heat capacity and was most economical. Due to evaporation effects the pond's energy efficiency could be enhanced significantly by suppressing evaporation from the fresh water layer. Experimentation is continuing in this area.

#First Award - General Motors Corporation
Third Award - Bureau of Reclamation/U.S. Department of the Interior
Fourth Award - General Motors ISEF
Alternate to Scholarship - Ohio State University
Honorable Mention - U.S. Department of Energy

USING SUPERCRITICAL XENON AS A SOLVENT FOR OPTICALLY ACTIVE ORGANIC MOLECULES: A POSSIBLE NEW TECHNIQUE FOR ACHIEVING ELECTRICAL PUMPING OF DYE LASERS

Mark Raboin Swain, 11008 Lee Highway, Manassas, VA 22110

Stonewall Jackson High School, Prince William County, VA

The approach in this project is based on the use of supercritical xenon as a solvent for dissolving the dyes used in a dye laser. My preliminary experiments showed that supercritical xenon dissolved organic dyes better than liquid xenon.

To determine whether xenon would function as a supercritical solvent, an experiment was conducted comparing the flourescence of pure xenon to a mixture of xenon and coumarin 540, a common laser dye. The flourescence profile of the cell was then examined from 400 to 650 nm by sampling every five nanometers, using a monochrometer and a calibrated photomultiplier tube. To establish the cell's potential for lasing, the concentration of the coumarin molecules dissolved in the xenon was determined by measuring the light absorbed by the solution and by using the Beer's Law formula.

These experiments clearly show that supercritical xenon acts as a solvent for the dye coumarin 540. This is evidenced by the tremendous increase in light output with the addition of the coumarin dye. Furthermore, since the threshold concentration for superradiant lasing of coumarin is approximately 10^{-5} moles, there is a substantial possibility that the solution will lase, since it has a concentration significantly greater than 10^{-6} moles.

The work described here represents a large step towards the realization of a practical electrically pumped dye laser. This work is on-going and during the next phase of this project, it is hoped that laser action in the xenon/coumarin 540 solution can be demonstrated using optical and electron beam pumping techniques.

#First Award - United States Army
Scholarship - United States Navy/Office of Naval Research
First Award - Vacuum Technology Division of the American Vacuum Society
First Award - American Committee for the Weizmann Institute of Science
Third Award - General Motors ISEF
Honorable Mention - Optical Society of America

THE APPLICATION OF SIMPLE AEROFOIL SYSTEMS ON VARIOUS WING TYPES

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An aerofoil (airfoil) is a structure that along with the main wing body, makes it possible for an airplane to fly. This is due largely to the aerodynamic force of lift, which is simply a pressure difference on the top and bottom of the wing. It would be interesting to experiment with these airfoils and attempt to create other functionable systems. The purpose of this project was to experiment if a simple airplane model is able to fly with variations in its wing structures. In this study three different wing types were used: a delta wing, a double wing, and a single wing. Four types of airfoils were used: a single airfoil, a double airfoil, a single frontal airfoil, and a combination of a single-frontal airfoil and a double airfoil. Before launching the plane from a functionable catapult, predictions were made according to physical laws. After launching the planes the results were somewhat expected but equally surprising. A double airfoil system proved to work on a delta wing and on a double wing. The application of a single frontal airfoil proved to be unworkable, but a combination of a frontal airfoil and a double airfoil seems to be a workable system. But these results are only partial, because further research and experimentation are needed to perfectionate the possibly workable systems.

THE EFFECT OF FISHING PRESSURE ON THE GROWTH RATES OF THE WALLEYL POPULATION IN MILLE LACS LAKE

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The intent of this study was to determine whether fishing pressure has influenced the growth rate of the walleye population on a heavily-fished lake such as Mille Lacs, Minnesota.

It was hypothesized that growth rates of walleye populations should increase with an increase in fishing pressure because of certain biological factors to be discussed in this paper.

Through the use of a technique demonstrated to this investigator by the Fisheries Research Department at the Grand Rapids Department of Natural Resources, the growth rates of walleye populations before and after heavy sport fishing was introduced to Mille Lacs were compared. This was accomplished with the help of a computer program that calculates the growth rates of fish populations.

After the back-calculated growth rates were statistically compared, it was found, at a 90% confidence level, that age 1 through 3 year walleyes do indeed grow faster now than before heavy sport fishing was present. Ages beyond three showed no significant increase.

#Fourth Award - General Motors ISEF

#THE EFFECTS OF ROETGEN RAYS ON MUSCA DOMESTICA

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Because of nuclear reactors, nuclear weapons, and talk of nuclear war, radiation in the last few decades has become a big controversy. My project was to find in a house fly if the life span would be effected, and how extensive the damage would be to the offspring of flies when exposed to radiation from an x-ray. I exposed newly hatched flies to different degrees of radiation from x-rays. I then raised the flies, gathered the eggs, cultured eggs through metamorphosis until hatched into adult flies. I then observed offspring through a stereoscope recording normalities and abnormalities, and total life span of both groups (offspring and adults).

I found that the life span of my control group was an average of 31 days. The total life span average of the offspring was 18 days. Here I found that the life span was reduced 13 days (or 42%) compared to a normal fly. The average mutation in the control group was 24% while the average in the exposed group was 56%. The exposed flies have a 32% greater mutation than regular flies. Thus I found that the exposed flies were greatly effected by the radiation from an x-ray.

#Fourth Award - General Motors ISEF

#DOMINANCE BETWEEN TWO RECESSIVE EYE COLORS

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The purpose of my project was to cross Drosophila in order to see if it were possible for one eye color mutation to occur more often than another eye color mutation.

After gathering my materials and deciding upon the methods of breeding, I started the experiment. After completing the crosses and recording the number of flies in each phenotype, I have a completed table of observations. The chi-square test was used in order to test the credibility of my observations. I used these observations to develop my conclusions.

The flies I used in my experiment were white; sepia ebony females and wild type males. The white; sepia ebony fly has two recessive eye color mutations. One of these mutations is of white eye color and the other is of sepia eye color.

My hypothesis stated that it would be possible for the sepia eye mutation to be dominant or occur more often than the white eye mutation. According to a Punnett square, the white eye color should have outnumbered the sepia eye color 1.25 to 1.

My results came very close to the results predicted by the Punnett square. The chi-square test results stated that the ratio of flies I observed would be duplicatable between 70 and 90 percent of the time. Unfortunately these findings were exactly the opposite of my hypothesis. Therefore, in this instance, white eye color mutation tends to occur more often than the sepia eye mutation.

#Second Award - General Motors ISEF

#AN ECOLOGICAL STUDY OF BULIMULUS GUADALUPENSIS IN PUERTO RICO

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Among the gastropods of the family Bulimulidae we have a species that has been a controversial one for years. This species , Bulimulus guadalupensis (Bruguiere, 1789) has been used as the basis for this investigation.

The main objective of this work is to determine if this species is undergoing subspeciation. Sixteen different shell patterns were found of which seven were chosen for the study along with B. guadalupensis Eyriessi (Drovet) which is known subspecies. Two permanent stations were selected: San Germán (5), and Sabana Grande (2).

To test out the hypothesis four aspects have been studied in each pattern: ecology, morphology, biochemistry and behavior. The ecological and biochemical phases failed to show significant differences. Statistical analysis of morphological traits showed significant differences in length and weight for the 8 patterns. The behavioral phase indicates the patterns are beginning to become identified with a particular behavioral pattern as shown by statistical analysis. Results seem to indicate the snail is undergoing subspreciation with the Eyriessi variety being the most advanced pattern in the process.

#First Award - Eastman Kodak Company
Third Award - General Motors ISEF

FACTORS INFLUENCING PLANARIA REGENERATION

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This experimentation dealt with the regenerative abilities of planaria, Dugesia doratocephela. Different factors were tested in trying to reduce the time span required for the complete regeneration of planaria.

The planaria is in the Platyhelmenthes Phylum and in the Class Turbellaria. Due to the presence of the mesenchyme cell, the planaria has the ability to regenerate.

This experimentation consisted of two phases. In the first phase, the planaria was disected vertically into two equal sections. In the second phase, the planaria was disected vertically into three equal sections. These two phases were used in each of my seven experiments; vitamins, minerals, pH levels of water, X-Ray radiation, color of light, intensity levels of light, and temperature levels of water.

The results of this experimentation are as follows: vitamins are much more effective than minerals in decreasing the time span required for the regeneration of planaria. Acidic water is helpful in the diminution of the time span required for the regeneration in planaria. Planaria cannot regenerate after being exposed to X-Rays. Planaria can regenerate fastest under gray light. Planaria regenerate fastest when exposed to a small amount of light. Planaria regenerate fastest in cooler temperatures.

The information gathered after the experimentation was completed, and the results interpreted, it was concluded that the time span required for complete regeneration of planaria can definitely be decreased and increased by external and internal factors.

PALATABILITY OF NINE COMMERCIALLY AVAILABLE HERBACEOUS PLANTS FOR BOBWHITE QUAIL

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Wildlife biologists use food plots to provide food and cover for quail. The purpose of this project is to rank commercially available herbaceous plants as to their palatability for Bobwhite quail. It is true that the palatability of food for quail is not a primary survival concern, but a food plot which contains plants palatable to Bobwhite quail will be more utilized than a food plot which has fewer or no plants palatable to Bobwhite quail.

The experiment was conducted using five Bobwhite quail(Colinus virginianus) and nine different seed species. The seeds were fed to the quail two species at a time. In this way each bird was given a choice between two species. Each specie was paired with all of the other seed species. The birds choice was determined by the mass eaten of each seed species. The birds were allowed to feed on the seeds for approximately twelve hours. Between each test day, a day was provided for the birds to feed on gamebird mash. This process insured the birds nutrition.

The following is a list of the seeds experimented with and their rank in the palatability test: German Foxtail Millet 1, Egyptian Wheat 2, Hairy Vetch 3, O.K. Gamebird Pea 4, Johnsongrass 5, Korean Lespedeza 6, Partridgepea 7, Sesbania 8, Common Sunflower 9.

Each seed specie was chemically analyzed as to the amount of crude protein, calcium, and phosphorus it contained. When this data was compared to my palatability data I found that the quail preferred the seeds which had the least nutritional value.

#Third Award - General Motors ISEF

CONDITIONED LEARNING: THE CHEMOTACTIC ABILITY IN THE LARVAE OF DROSOPHILA MELANOGASTER

Rivers, David B. Western H.S., Russiaville,Ind 46979
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My project dealt with training Drosophila larvae to learn through conditioning. The larvae were conditioned by blowing two chemical odorants, Benzaldehyde and Amyl Acetate, into a ninety millimeter petri dish filled with agar-agar. Each odorant was blown in seperately for thirty seconds with one odor having a ninty volt eletric current passed through the dish at the same time.Learning was determined by a majority of the larvae crawling to the odor without electric shock associated with it. This type of training is known as punishment learning. I compared this learning with reward learning. The reward training used sucrose instead of electric shock.My experiments indicate that Drosophila larvae show a simple form of associative learning.

A STUDY OF NERVE TRANSMISSION

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Many of the functions performed by humans and other living organisms require extensive and continual use of their nervous systems. The earthworm is an example of an invertebrate in which nerve transmission can be studied. Experiments are designed, constructed, and carried out to make possible the study of nerve transmission in Lumbricus Terrestris (earthworms - annelids). The principal equipment utilized in this study is: an oscilloscope, preamplifier, power supply, and electrode dish. Annelids are placed on the electrode dish, and stimulation is applied. When nerve impulses are detected, their amplitude and time duration are measured. Thirty-three experiments are carried out and recorded in the log book in which (1) annelids of different sizes are studied, (2) both anterior and posterior stimulation is investigated, and (3) the distance of separation of the electrodes is varied. Photographs as well as pen traces of oscilloscope signals are utilized to record important details of the experimental data. Analysis of the results reveals significant differences between stimulation from the anterior and stimulation from the posterior. "Action potential" responses, characterized by sharp small-amplitude peaks and troughs of short time duration (few milliseconds), are observed in these experiments only when stimulation is applied at the posterior. Responses of a completely different type, characterized by broad, large-amplitude peaks and troughs of long time duration (tens of milliseconds), are observed in experiments with both anterior and posterior stimulation. These latter responses are interpreted as "muscle movement" responses. The characteristic velocity of wave propagation for each set of nerve impulse responses is determined from an analysis of the experimental data. Figures 1, 2, 3, and 4 provide these results on the velocity of wave propagation for both "action potential" and "muscle movement" responses. The data demonstrates that the velocity of wave propagation for large Lumbricus Terrestris is greater than that velocity for narrow Lumbricus Terrestris, independent of whether the stimulation is applied at anterior or posterior. An analysis of the results is provided in Figure 5 for the determination of refractory time for "action potential" impulses. This refractory time is estimated to be in the range of 2 to 4 milliseconds.

ANTS AND ANT HILL STRUCTURE

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The purpose of this project was to find the reason for the shape of ant hills and provide more information toward control methods.

While taking measurements of ant hill slopes,I found that one slope was longer and lower than the other four slopes. A hypothesis was then formed that these slopes are formed in accordance with the environment and sun to be able to capture as much as possible of the solar energy allowed each individual hill in its differing situation. For example: if you compare the eastern slope of a hill to a 90 degree angle and the western to a 45 degree angle, when the sun is directly overhead, the 45 degree angle will recieve the most solar energy. This would be ideal if there was a mountain range to the east, because the ant hill would get most sunlight from the west; but two 45 degree angles would be better in an open space. Steeper angles would work better in valleys and other areas where direct sunlight can be recieved for only a few hours of the day.

To prove this theory I took temperature readings of four different hills during different seasons of the year. My findings were that by collecting solar energy, ant hills retain a higher temperature than the air and soil surrounding them.

These findings could be used to design energy efficient homes (by sloping rooves to capture sunlight at the angle that most light is recieved), building solar collectors that do not need to be turned by mechanical means, and providing information toward controlling ant problems on farmlands.

#TRAIL PHEROMONES OF FIRE ANTS: USE OF HYDROCARBONS TO DEFINE TWO TRAIL TYPES.

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Red imported fire ants Solenopsis invicta follow artificial trails made with several solvent extracts of homogenized ants; such as diethyl ether, ethanol, water, petroleum ether, or pentane. The solubility characteristics indicate that the trail molecules in these extracts are a mixture of compounds including long-chain hydrocarbons. Of several long-chain hydrocarbons tested, pentadecane was shown to cause trail following.

All solvent extract trails persisted for at least 4 hours suggesting that there are trail molecules less volatile than the highly volatile trail pheromone, discovered in this species by Wilson (1962), which dissipates in 20 minutes. Observations on natural trails supported this interpretation. Food foraging trails persisted for only 30 minutes while nest relocation trails remained effective for 7 hours.

This is the first time it has been reported that different trail types have different longevities. I suggest that ants specify their two types of trails by varying the relative concentrations of the short-chain (highly volatile) and long-chain (less volatile) hydrocarbons they secrete. However, since I also observed that the longevity of pentane extract trails increased with the concentration of extract used, the lifetime of a trail might additionally be regulated by the quantity of pheromone laid down.

#Third Award - General Motors ISEF
Honorable Mention - American Psychological Association

EFFICIENCY OF SINUSOIDAL AND SQUARE WAVES ON THE RANA PIPENS

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Atrophy sets into a muscle upon termination of activity. Diminution in the size of a cell, tissue, or organ results. An excitability potential may be retained through induced electrostimulation. Through the use of a synthesizer and an oscilloscope, an analysis may be made to determine the efficiency of the induced sinusoidal and square waves; the gastrocnemius muscle of the Rana Pipens was stimulated for experimentation, as the muscle deteriorates slowly. It was concluded that the sinusoidal wave has a submaximal value of 55 millivolts, and the square wave, 60 millivolts. Sinusoidal waves have less distortion than square waves. Square waves contain a supramaximal value of 70 millivolts; this was the greatest reaction from a given muscle. On a clinical basis, each wave form has its advantages, and are of equal efficiency.

IMPORTANCE OF SOW HEMATOCRITS

Richtsmeier, James L., Clifford-Galesburg H.S., Galesburg, N.D. 58035
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I was interested to see if higher hematocrit levels in the sow produced more pigs born alive, heavier litters, and higher hematocrit levels in the little pigs. The sows' blood samples were taken from the jugular vein. The little pigs' blood samples were taken from the vena cava. The blood was then sent to the North Dakota State University Lab. I found that higher hematocrit levels in the sows did produce more pigs born alive. The sows with 36% of hematocrits or higher had an average of 1.35 more pigs born alive than the ones with 35% or lower. On a one hundred sow, farrow to finish operation, this could produce $11,000 more profit. The sows with higher hematocrit levels also produced heavier litters and higher hematocrit levels in the little pigs.

YOGHURT: THE NATURAL ANSWER

Duval, Dawn Louise, Elko High School, Elko, Nevada 89801
Arthur Rt,, Wells, Nevada 89835

Enterotoxemia is a disease which often infects lambs and kills them. In treatment of this disease, regular doses of Clostridium perfingens Types C & D Antitoxin and Oxytetracycline are administered. The regular use of these antibiotics destroys bacteria that promote digestion in a lamb's stomach and intestinal tract. This study searched for a common agent that was easy to administer and palatable to lambs. The agent found had Lactobacillus bulgaricus and Lactobacillus acidophilus as its main Lactic cultures. This agent, a powdered yoghurt culture, was tested against yeast, Probiocin (a commerical bacteria replacement paste), commerical milk replacer, and yoghurt. In this test, the powdered yoghurt culture showed the greatest growth of bacteria. It was also found to dissolve readily in both milk and water thus making it easier to administer to young lambs than the commerical bacteria replacer. When this substance was tested on lambs experiencing the problems which develope with the treatment of enterotoxemia they recovered completely in about one week.

#THE EFFECT OF CITRUS OILS ON THE IMPORTED FIRE ANT

Newsom, Brent A., Woodham High School, Pensacola, Fl. 32503
225 Man-O-War Circle, Cantonment, Fl. 32533

The purpose of this project is to determine the effectiveness of citrus oils as ant insecticides and to establish methods for control of ant populations using the most potent of these natural insecticides.

Citrus oils were isolated from outer rind sections of the lemon, lime, orange, tangelo and grapefruit. 3 cc sprays of each oil were applied to ants and rated for potency ("kill time"). Lime oil was most potent, followed by lemon, grapefruit, orange, and tangelo oils. When these oils were rated according to relative acidity with pH test paper, it was noted that the degree of effectiveness as an insecticide is proportional to its acidity.

Barriers of lime oil were shown to be effective in controlling ant behavior. Ants could be contained within a 6" diameter ring of lime oil for 6-8 minutes. This citrus oil was also shown to be an effective repellant when barrier lines were moved across a rectangular area gradually clearing the area of ants.

Lime oil mixed with a protein food source (egg yolk) was used as a toxic bait. The delayed "kill time" (4-18 minutes) is desirable for toxic baits. The delay allows for transportation of the bait to the nest thus potentially destroying the entire colony. When lime oil was mixed with a commercial insecticide, the potency was retained. Blends of natural and artificial insecticides could reduce the use of harmful chemicals.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society

#A PARASITOLOGICAL STUDY OF THE TREE FROGS ELEUTHERODACTYLUS COQUI AND ELEUTHERODACTYLUS PORTORICENSIS IN WESTERN PUERTO RICO.

Santos, Víctor D., Lola R. de Tió High School, San Germán, P.R. 00753; Res. Las Lomas Edif. 14 Apt. 39, San Germán, P.R. 00753.

The genus Eleutherodactylus in Puerto Rico is represented by some 17 species. Among them we find two, Eleutherodactylus coqui and Eleutherodactylus portoricensis which are considered the national symbol of the island. These two species produce an onomatopetic sound ("coqui") which is very dear to all puertoricans. This study is an attempt to study in detail the parasitological fauna of these the two most common species of the genus Eleutherodactylus in Puerto Rico.

A total of 20 stations were selected, mainly in western P.R. A total of 465 frogs were collected, 314 specimens of E. coqui and 151 specimens of E. portoricensis. A total of 5,653 parasites were found with 4,348 in E. coqui and 1,305 in E. portoricensis. Among the parasites found we have nematodes as the most abundant, with pentastomides, trematodes, cestodes, acanthocephalans and acarines also present. Incidence of infection shows a 73.25% for E. coqui and 75.49% for E. portoricensis. Most parasites were found as expected in stomach and intestine with some in lungs, kidney and liver.

The study revealed that Mesocoelium danforthi, a trematode, Oxysomatium portoricensis, a nematode, Lueheia inscripta, an acanthocephalan, a cestode, a pentastomide, and an acarus are found in both species. A number of other species of nematodes, most probably new species were also found in both. Both species of frogs represent new host records for the cestode, the acanthocephalan, the pentastomide and the acarus. E. coqui represents a new host record for Mesocoelium danforthi and Oxysomatium portoricensis.

#Honorable Mention - Eastman Kodak Company

SEEING IS BEE-LIEVING

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The effects of Ultraviolet light and shape recognition were tested on the visual perception of Apis meillifera. Bees respond to the Ultraviolet portion of the spectrum, enabling them to see every color except for red. The researcher wished to see if colors combined with specific shapes resulted in significant interaction causing favoritism by the bees.

A four part procedure was designed to determine if an interaction does exist between the Ultraviolet light and shapes. The four test sets consisted of five tests, each lasting 30 minutes. Glucose was used as a food source, and distilled water was used as the control. Barriers of plexiglass were used to keep the bees from indiscriminately landing on any color. To keep the bees from reacting habitually, the colors were moved every five minutes except for those on the fixed board. From the first three test sets it was concluded that the most highly populated colors were white, violet, and blue. These were the colors used on the four basic shapes.

ANOVAs were run on the results from each test set. The conclusion was that color choice was significant at the .01 level. It was not chance that the bees landed mostly on these colors. Findings as to shapes were not significant, and interaction between the two, colors and shapes, were not significant.

Low N's were counted on all boards containing the plexiglass barriers. This was believed to be due to the bees running into the boards, bouncing off, and flying away.

#Third Award - General Motors ISEF
Honorable Mention - American Psychological Association

DOMINANT SPOT AND WHITE BANDING: A LINKAGE STUDY IN THE SYRIAN HAMSTER

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The problem I am studying is the inheritance of two coat color patterning genes, dominant spot and white banding, in the Syrian hamster.

My hypothesis is that the genes dominant spot and white banding are linked.

To test for the presence of linkage, a dihybrid testcross is performed. An animal which is heterozygous for both loci is crossed to an animal which is homozygous recessive for both loci. Linkage is indicated by a deviation from the expected 1:1:1:1 ratio observed in dihybrid testcrosses.

Testcrosses were performed with heterozygous males and homozygous recessive females. Reciprocal crosses were also performed.

All of the testcrosses completed thus far are tests for linkage by coupling. I observed a 16:29:28:32 ratio of dominant spot/banded: dominant spot:white banded:wild type. This fits a 1:1:1:1 ratio expected without linkage.

From the linkage data collected, I have concluded that the genes dominant spot and white banding are not linked; or if they are on the same chromosome, fifty percent recombination has occurred. Results of crosses where fifty percent recombination has occurred and where no linkage is present appear the same. I have also concluded that sex does not affect the inheritance of the genes dominant spot and white banding. I can draw this conclusion because reciprocal crosses were done and approximately the same results were observed.

THE EFFECT OF A PROTEIN STIMULANT ON THE REGENERATION TISSUE OF A FLATWORM

Couvion, Eric A., Christoval I.S.D., Christoval, TX 76935
301 Rudd ST., Christoval, TX 76935

Regeneration of tissue is a growing area of study. My research and experimentation study the effect of two proteins added to the tissue of a planaria. The question is, does protein speed up the process of regeneration tissue?

Planaria, gathered at the Concho River, were separated into groups of ten and placed in separate troughs. The two proteins were added to the troughs, one drop per day and two drops per day. After one week the planaria were cut, one cut per planaria (four different cuts were used). In addition to the protein stimulant added to the water, other stimulant were added to the other groups. These consisted of electrical shocks, vitamin additives, and the control (no stimulant added).

After the cuts were made on all the groups, they were observed until total regeneration had taken place. The lengths of the planaria (before and after cutting) were recorded as were the times of complete regeneration.

Tissue samples were taken from the planaria at the time of cutting and after the regeneration process had taken place.

The results are very clear. The animal protein (two drops added per day) increased the regeneration process by 1/3 of the control regeneration time. The instant protein also sped up the regeneration process, although only 1/4 faster than control. All of the other variables also increased the process.

Through my experiments I have learned that a protein stimulant does speed up the process of regeneration. This would mean that a fingernail (for example) will grow back faster if a protein is added to the body.

ESTIMATING POPULATION DENSITY AND DETERMINING SEASONAL CHANGES IN THE MORPHOLOGY OF PEROMYSCUS MANICULATUS IN A PRAIRIE BIOME ON THE BLACKFEET INDIAN RESERVATION, GALCIER COUNTY, MONTANA

Doore, Roylene M., Browning High School, Browning, MT 59417; Box 1380
Browning, MT 59417

The purpose of this preliminary investigation was to determine the population of Peromyscus maniculatus using the mark-capture technique and to determine seasonal changes of weight and size in the animals.

It was thought by the researcher that the population of these mice on a prairie biome in Montana was very dense. With this belief in mind the present research was initiated.

Ten Sherman traps were placed on a ranch in Glacier County, Montana during the fall and winter seasons, in 1984, to capture deer mice. The animals captured were etherized, measured, weighed, marked and released. The population estimate of the study area was 46 mice, with the density being one mouse per 755 m^2. The smallest mouse was caught on October 4th and weighed 19.2 g., and the largest mouse was caught September 19th and weighed 19.2g. In general, the animals were decreasing in mass as the season changed from fall to winter, as can be seen by the general decrease of mass from 14.9 g.$\bar{x}$ in the precensus to 11.8 g.$\bar{x}$, in the census group. The student t test showed a probability of 2.88 for weight change from fall to winter. Entering at the 40^{D} of freedom level the 2.88 value is very significant at the .01 level of distribution which indicates that the two populations were significantly different groups. This test shows that this situation was not due to chance alone. Also, the t test showed that there was no significant difference in the change of length in the animals from fall to winter.

PATTERNS OF BEHAVIORAL DEVELOPMENT IN THE NORTH AMERICAN ELK

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During June, July, and August of 1984, patterns of calf development were studied in a captive population of North American Elk at the Minnesota Zoo. There were sixteen elk in the herd that was studied: two adult males, seven adult females, and seven calves born during May and June of 1984. Several sampling methods were used during the study to record calf behavior. During the preliminary observations all occurrences of nursing and grooming observed between the herd members were recorded. During the remaining period of study, occurrences of fifteen different behaviors were recorded by the observer. The results of the preliminary study were conclusive in that the dam of each calf was determined with a reasonable degree of certainty. These results were reinforced during the remainder of the study. The results of the primary study were less conclusive as patterns of development differed widely between calves. The results of the preliminary study are valuable to the Minnesota Zoo in order to maintain accurate records. The results of the primary study may also be helpful to field observers and zoo staff as a basic comparison to what they observe.

THE EFFECTS OF LIGHT ON BRINE SHRIMP

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THE EFFECTS OF LIGHT ON BRINE SHRIMP

This experiment shows the effects of different colored light on the growth and behavior of Brine Shrimp. Survival is longest in white light. Growth rate is fastest in black or blue light. Purple or orange light produce the largest shrimp. Life span is shortest in orange light. In early stages of life the shrimp in darker colored light remained deeper; whereas the shrimp lived nearer the surface in light of lighter colors.

THE EFFECTS OF X-RAY RADIATION ON DROSOPHILA

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This project presents the damaging effects that x-ray radiation can inflict on the living cells of Drosophila. The initial objective was to determine the effects of x-ray radiation on the chromosomes of Drosophila, and to compare the radiated chromosomes to the normal ones. The flies were divided into four groups: (0) Control; (1) 8.35 Rads; (2) 32.42 Rads; and (3) 133.68 Rads during the larval stage. Following radiation, chromosome smears were made; however, the objective failed when microscopes of strong enough magnification were not available. The objective was then changed to the comparison of the exteriors of the mutated flies with those of the normal flies. The final objective was to transfer these mutations onto film. Slides were made of the mutations, then placed under a microscope which had an Olympus Instant Camera and mount. Pictures were then taken of these slides. Mutations became visible at 32.42 Rads. The most visible mutations developed in the group that was exposed to 133.68 Rads. In that group, mutations occurred in the head, wings, and bristles (hair). The question answered was that radiation does affect the living cells when exposed to 32.42 Rads or more. (This hypothesis could be the basis of research on the effects of radiation on humans.)

A STUDY OF THE SYMBIOTIC ASSOCIATION BETWEEN THE PEN SHELLS *PINNA CARNEA* AND *ATRINA RIGIDA* AND THE FISHES *ASTRAPOGON STELLATUS* AND *ASTRAPOGON PUNCTILLATUS*.

Graham, Adrian R., Lola R. de Tío High School, San Germán, P.R. 00753; Box 480, San Germán, Puerto Rico 00753.

This study represents an attempt to describe the symbiotic association between the pen-shells *Pinna carnea* and *Atrina rigida* and the fishes *Astrapogon stellatus* (Cope) and *Astrapogon punctillatus* (Poey) in the shallow waters of southwestern Puerto Rico. Eighty four pen-shells were collected and 22 fishes were obtained from four stations.

Host specificity trials were conducted to test the preference of the fish towards its natural host. Three different figures and eight colored pen-shells were also used to test for preferences.

Astrapogon species preferred *P. carnea* over *Strombus* 100% to 72% with an average time difference of 2:43 to 2:48 seconds. They preferred *A. rigida* over *P. carnea* 96% to 91% with an average time of 1:28 to 1:09 seconds.

Tests conducted to find out if the fish locates its host in its natural environment using visual cues indicates that the fish appears to be attracted to the pen-shells by visual recognition and that distance is an important factor. Preference for any color was negative.

Tests conducted to determine if olfaction plays a part in the location of its host showed it does not.

Association in this case seems to be facultative commensalism. *Astrapogon punctillatus* (Poey) is reported for the first time as a facultative symbiont of the pen-shell *Pinna carnea*.

BIOLOGICAL ASPECTS OF THE CAVERNICOLA *ANOPHTHALMUS CANTERONENSIS* (BOSC, 1951) (ISOPODA: FLABELLIFERA) FROM SOUTHWESTERN PUERTO RICO

Cardona, Rodger, Lola R. de Tío High School, San Germán, P.R. 00753; 10 Javilla Street, San Germán, P.R. 00753.

This investigation attempts to increase our knowledge of the cavernicole *Anophthalmus canteronensis* (Bosc, 1951), an endemic cave dweller from southwestern Puerto Rico. Practically nothing is known of the biology of this very interesting genus. This species is found in Cueva de Monte Grande in Lajas Barrio, Puerto Rico living sympatrically with the cosmopolitan species *Porcellionella americana* (L.) A comparison of both species has helped us to improve our knowledge on this species.

Study involves a description of the cave, environmental parameters of a 24 hour period, taxonomy, population, competition, food items, cannibalism, predators and particularly internal parasites. External and internal anatomy has been studied. Measurements of length and width of body, three legs, antennae and wings were taken and standard deviations determined, for each measurement, for males and females. Phallus, antheca digestive tube and enzymes have been studied. Phallus indicates it is a primitive mouth. *Anophthalmus* is ovoviviparous and bigger than *Porcellionella*.

Chemical analysis was carried out to determine water, organic matter and mineral content. Protein concentration and amino acids were compared. Oxygen consumption, osmoregulation, righting response, ranges of antennae movement, velocity, surfaces they climb and grooming behavior have been studied.

Twenty five roaches were examined for parasites and 574 nematodes were found in the hindgut. Parasites are in the processes of being identified.

Student Award - Entomological Society of America

*EQUIANGULAR SPIRAL GROWTH PATTERNS IN FOSSIL AND RECENT FORAMINIFERAN AND MOLLUSCAN LIFE FORMS

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Many life forms exhibit a characteristic growth pattern known as the equiangular or logarithmic spiral. The purpose of this research was to use a "high tech" approach to the study of certain aspects in the life histories of several species, three of one-celled foraminifera and seven of mollusca. The intricate structures of these spiral shells were investigated to correlate to respective growth patterns of the animals when they existed.

The foraminifera, both Miocene and recent, were collected from Maryland and supplied by the Smithsonian Institution. Scanning electron micrographs were made of the tiny tests for whorl measurements.

Radiographs of Nautilus were also made for determining the constant angles. Photographs using a 35mm camera were taken of the other various cephalopod shells ranging in size from 15mm to 0.7m and existing from lower Cretaceous to recent periods.

Measurements of adjacent whorl ratios were substituted into the formula: $W(n+1)/W(n) = e^{(\Phi \cot \alpha)}$ to solve for alpha, the constant angle.

Radiographs, SEM, and photographs provided excellent results. In the mathematical relationships, the greater whorl breadths yield smaller constant angles. Also larger whorl ratios mean that the animal grew at a rapid rate. The calculations in this research included mean constant angles for all specimens, which ranged from 74.6° in Nonion pizzarense to 88.2° in the protozoan nummulite.

The conclusions from my studies were that there were no significant differences within any given species. However, seven of the ten species examined showed considerable changes in growth rate.

*First Award - Eastman Kodak Company

A FOUR YEAR INVESTIGATION INTO THE CONTROL OF THE COMMON CAT FLEA, CTENOCEPHALIDES FELIS (BOUCHE')

Blake, Julia J., Suwannee High School, Live Oak, FL 32060;
312 Gay Street, Live Oak, FL 32060

The purpose of my project is to find the most effective way to kill the common cat flea, Ctenocephalides Felis (BOUCHE'), which is the flea that is most often found in Florida on house pets.

My hypothesis is that some products are better than others in controlling the common cat flea, and my experiments will determine which is truly best.

The materials I used were commercial flea powders and sprays, insecticides used by qualified pest control operators, talcum powder, tobacco dust, diatomaceous earth, fleas, eggs, cocoons, carpet, sand, blood meal, hatching apparatus, test tubes, jars, cotton, organdy cloth, and tissue.

Over a period of four years, I did various experiments using flea powders, sprays, insecticides and chemicals. I tested them and compared the results. I developed a formula for a homemade flea powder.

I found that generally flea sprays worked better than flea powders and that the homemade flea powder worked better than the commercial flea powder. In the test with the insecticides on carpet, any of the three insecticides used in the experiment will effectively control live fleas, but Dursban or Flcam Plus would be more effective on both live fleas and cocoons. In the test using insect growth regulating chemicals, I found that on flea eggs Safrotin in 10, 5, and 1 parts per million concentrations and Dimilin in 10 ppm concentration appeared to be most effective. On larvae, Methoprene in 1 and .1 parts per million concentrations appeared to be most effective.

COMPARATIVE STUDY OF TROUT FEEDING HABITS

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The research conducted in this project focused on the feeding habits of native trout, collected with fly-fishing tackle from a variety of streams. The original plan, developed in June 1984, had to be adapted in several areas before the final data was completed.

Trout were collected from a total of eight streams in Pennsylvania and Virginia. The stomach contents of each trout was preserved and later, examined. All organisms in the stomachs were counted and identified by order. A survey of the organisms available to the trout was undertaken on Slate Run, (habitat for both brook and brown trout) and on Falling Spring Branch (rainbow trout). From the date collected on the organisms consumed and the organisms available in the streams, I attempted to compare the two in order to determine which organisms were being selected by the trout. (Note: This could only be done with the trout collected from the two streams from which kick samples had been taken.) The formula for electivity was used, that is; $E = (ri-pi)/(ri+pi)$ ri = % consumed, pi = % available.

No definite conclusions were reached in this research, although a few suspicions have been strengthened. The role of midges (Diptera) in the trout's diet has been greatly underestimated for the most part by fishermen. It should be noted that the order Diptera had the highest electivity values in the diets of all three trout species. Also interesting was the large number of terrestrial insects encountered in the trout stomachs. However, only benthic organisms were used for comparative purposes in this study.

A STUDY OF THE POLYCHAETE HERMODICE CARUNCULATA IN PUERTO RICO WATERS

Martínez, Milton, Lola R. de Tío High School, San German, P.R. 00753;
12-C-17 Repto. Universidad, San Germán, P.R. 00753.

The organism which is the object of this study is known scientifically as Hermodice carunculata (Pallas). This particular polychaete is frequently found in algae, octocorals, stony corals, Thalassia beds, under stones and in the small zoan thid, Zoanthus sociatus. This paper is an attempt to study aspects of the ecology, behavior, and biochemistry of this worm, and to compare it with the less abundant fire worms Eurythae complanata and Chloeia viridis. A special attempt is being made to study learning ability in this species.

To carry out this study, six stations were selected along the southwestern coast of the island. The environmental parameters were determined. Field work was carried out to find the specimens of all fire worms present in each station. A number of the fire worms were washed each station with magnesium chloride in a 7% solution to remove copepods or all other organisms adhered to the surface of the worms. Twenty five specimens of Hermodice were measured as to length, weigth and width. A biochemical analysis of Hermodice was carried out to determine the amino acid content of fire worms, water, organic matter, mineral content, and photosynthetic pigments present in the fire worms. Since Hermodice can be found in a variety of colors, several extractions were carried out. The velocity of fire worms and preference to light and darkness was determined. Olfaction was found to be important in the localization of prey by the worm. The anemones Bartholomea annulata and Stoichactis helianthus were used. Alpheus armatus was confirmed as enemy of Hermodice. The anatomy of the parapodia was studied.

The learning capacity of H. carunculata was determined and compared with that of 3 other polychaetes. The worm was found to learn faster than the other three and to retain longer what it has learned.

#Third Award - General Motors ISEF

AN ECOLOGICAL STUDY OF GEOMYS pINETIS IN FLORIDA

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Geomys pinetis is a common fossorial mammal of the open mesic environments in Florida. Commonly known as the southeastern pocket gopher, Geomys are herbiverous and mainly crepuscular in activity. The gophers burrow consist of an intricate network of tunnels.

Buechner(1942) refers to possible economic problems caused by Geomys because of their burrowing and feeding habits.

With the similarity in habitat preference of Geomys pinetis and real estate developments in the southwest Lakeland area, this project(now in it's second year of a proposed three) was conducted to gather ecological data on the species. This data is to be applied to a possible relocation project if feasible.

The Florida Game and Fresh Water Fish Commision has implied that Geomys pinetis goffi of the Melbourne, Fl. area is endangered because of human encrochment on it's habitat.

An interesting fact found was burrow fauna. Various subterranean arthropods were collected inside the burrow. These included: the Florida camel cricket(Typhloceuthophilus floridanus); parasitic mites(Geomydoecus scieritus) ;beetles ;centipedes ;and a weevil like insect ,other unidentified arthropods were collected.This burrow fauna is similar to that described by Lee(1980).

#Fourth Award - General Motors ISEF

THE EFFECT OF VITAMIN "A" ON PLANARIAN REGENERATION

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The original concept for this experiment arose from the belief that if Vitamin "A" is rubbed on a wound, the wound will heal faster. The aim of this project was to determine if Vitamin "A" would have any effect on the regenerative abilities of Planaria, assuming that wound healing and cell replacement in Planaria follow similar biochemical processes.

The procedural design involved cutting two Planaria, Dugesia tigrina, of equal size in half immediately anterior to the pharynx. The posterior ends were isolated in seperate culture dishes designated control and experimental. The anterior ends were not involved in the investigation. Using a homemade micro-applicator, the cut surface of the experimental group would be coated with Vitamin "A". Vitamin applications were made daily along with observations.

Using the same procedure as with the Vitamin group, two types of controls were established. 1) Vegetable oil was applied to cut surface and 2) Nothing was applied to cut surface. All groups were maintained in natural spring water.

Two patterns of results were observed. 1) Both control groups followed normal regenerative patterns found in Planria. 2) The vitamin group demonstrated a greater probability of undergoing fission prior to normal regeneration.

Conclusions as to the effect of Vitamin "A" on the regenerative processes of Planaria can only be expressed as subjective theories at this time.

THE EFFECTS OF VITAMINS ON THE REGENERATION OF PLANARIA

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The effect of tocopherol upon the rate of regeneration of Dugesia tigrina was investigated. To determine this effect, concentrations of 1/ppm, 5/ppm, and 50/ppm of tocopherol were used. The tocopherol was mixed with lake water. The control was lake water with no tocopherol added. Each container had three Dugesia, and each concentration, as well as the control, was replicated three times. Each of the Dugesia was cut transversely into approximately equal halves. The Dugesia were measured daily to determine the amount of regeneration. The greater concentrations of tocopherol produced the most complete amount of regeneration in the shortest amount of time. Dugesia were not fed during this experiment.

MIRACIDIAL RESPONSE TO CHEMICALS EMITTED BY SNAILS VS GRAVITY

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705 East Washington St., Macomb, IL 61455

Purpose: To test and study miracidial chemotaxis response against their geotaxis response. Theories predicted that the miracidia will remain at the bottom of the test tubes.

Procedure: The Philophthalmus gralli were placed in petri dishes containing pond water and were allowed to produce miracidia. When the miracidia started to swim, a pipet was used to count out twenty-five to thirty miracidia. These were put into a test tube. This step was repeated until five test tubes were filled. A hypodermic needle was used to inject the test tubes with forty microliters of the testing chemical solution. Thirty seconds were allowed to pass; then a pipet was used to remove the top half of the pond water containing the chemical solution in the test tube. The number of miracidia found in the top half of the water were counted and averaged into the results.

Conclusions: The results showed that the geotaxis responses of the miracidia were greater than the chemotaxis responses. In addition, the chemotaxis responses were directly related to the horizontal experiments.

THE EFFECT OF WHITE LEAD ON HARVESTER ANTS

Passmore, Krista, Bay H.S., Bay, AR 72411
P. O. Box 518, Bay, AR 72411

The objectives of this experiment were to resolve how white lead affects the behavior, nest building, and death rate of harvester ants. Another objective was to determine if the effects of white lead would continue after the lead was removed from the ants' food and water.

Group A was observed for 27 days and received the lead solution throughout the experiment. Group B, which was observed 29 days, was given the lead solution for 20 days and tap water for 9. The Control Group was observed for 40 days, the intended observation time, and was administered tap water throughout the experiment.

It was concluded that the concentration of lead solution used in this experiment had a considerable effect on the nest building, behavior, and death rate of harvester ants. The lead, however, did not have a noticeable effect on the maintenance behavior of the ants. It was concluded that the harvester ants were permanently affected by the lead since there was no change observed after it was removed.

#THE EFFECTS OF SEVIN ON THE METABOLIC RATE OF THE ACHETA DOMESTICUS

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The purpose of this study was to determine the effects of the insecticide SEVIN on the metabolic rate of the Acheta domesticus, the common house cricket.

SEVIN is the Union Carbide registered trademark for carbaryl insecticide. Carbaryl's active ingredient is 1-naphtyl methyl-carbamate. SEVIN has been a widely used insecticide since the 1950's.

Acheta domesticus is the scientific name for the common household cricket. After food was withheld for 24 hours, the crickets were exposed to various amounts of carbaryl in the form of 20% carbaryl and 80% bait. A sub-lethal dosage was determined. It was also found that SEVIN administered orally increased the metabolic rate.

SEVIN was also applied topically to the ventrum of the abdomen with microliters of acetone as a solvent. Organisms were tested at LD50% for changes in the metabolic rate. At LD50%, the metabolic rate was found to decrease after 24 hours. A dosage mortality curve was also obtained.

The results of this study indicate that when the Acheta domesticus is exposed to the insecticide SEVIN, both orally and topically, the metabolic rate is affected.

#First Award - United States Navy
Alternate to London International Youth Science Fortnight/United States Navy/Office of Naval Research
Third Award - General Motors ISEF

HOW ALCOHOL AFFECTS CHICKEN EMBRYOS

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The purpose of my project is to determine what effects alcohol has on chicken embryos and to correlate my findings with Fetal Alcohol Syndrone. It is my hypothesis that the alcohol will produce adverse changes in the embryonic development of the alcohol-injected eggs. I also wish to prove that the alcohol will produce harmful changes in the liver of the alcohol-injected embryos. Moreover, I believe that the alcohol-injected embryos will display the same abnormal effects as a child with FAS.

The eggs were divided into 5 major groups and then into 2 subgroups (other than the normal). Eggs were injected and then later reinjected with alcohol or Ringer's solution. Eggs were opened and observed. Embryos were dissected; major organs were weighed. Slides were prepared of liver samples. Feather differences were observed through the electron microscope.

All alcohol-injected embryos were smaller in size and showed less feather development than the control and the normal. No alcohol-injected embryo lived to hatch. The livers of the alcohol-injected embryos were pale and discolored and showed adverse fatty changes. Necrosis of the liver was found in the embryos injected with alcohol. The feathers of the alcohol-injected embryos were smoother, finer, and shorter, showing immature development. My hypothesis was proven correct. All alcohol-injected eggs showed less development as evidenced by weight and length and feather development. None of the alcohol-injected embryos survived the second injection. Those embryos injected with alcohol were all in the first stages of liver disease. A parallel is evident between this and Fetal Alcohol Syndrone.

#CONTROL OF INSECTS THROUGH EXOCUTICLE DECOMPOSITION

Guffey, Andrea Weber High School, Pleasant View, UT 84404;
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Insects destroy almost 10% of the crops raised in the U.S. each year! Damages incurred by these pests totalled more than $8 billion in control costs and an untold amount lost to pathogenic parasites. The bot fly is one of these insects which causes thousands of dollars damage to the horse industry each year. They can cause malnutrition, colic, and even death!

Horsemen spend millions of dollars on deworming agents, but these chemicals are only effective on the inside of the horse; once damage has already taken place. Why not break the bot cycle before it starts, while the bots are still on the horse's forelegs? This is the problem upon which my project is based.

I gathered several hundred bot eggs from various horses and applied a 30% chitinase solution to the eggs. Within 12 hours, the chitinous rings in the eggs were completely decomposed, and thus the larvae were prematurely exposed to the atmosphere and they died.

I conducted further tests, trying to determine if the chitinase would be harmful to the horse or the environment in any way. I applied 30%, 60%, and 90% solutions of chitinase to both light and dark pigmented horse hair. After letting the hair soak for 72 hours, I conducted a microscopic inspection and found that the hair had no visible change in any way. The chitinase shouldn't have adverse effects on the environment or other mammals because it is found naturally in the moulting fluids of insects.

If chitinase could be marketed commercially, stress on the horse would be reduced, worming costs would be significantly less, and the chitinase could be used on other pests such as crickets and beetles.

#First Award - Entomological Society of America
First Award - United States Air Force
Second Award - General Motors ISEF
Second Award - United States Army

ARE TESTOSTERONES AND ESTROGENIC COMPOUNDS FACTORS INFLUENCING THE SPATIAL LEARNING ABILITY OF MALE AND FEMALE MUS MUSCULUS? A TWO YEAR STUDY

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The purpose of this project was to investigate the influence of testosterone and estrogen, the male and female sex hormones on spatial learning and spatial memory. The researcher observed that male and female mice which had received testosterone learned to run a maze faster than a control group. In addidion, the groups of mice that received estrogen showed a much slower learning rate than the control.

Twenty-four mice were run through a standard "T" maze three times and their times were recorded. After the third run, three of the male mice and three of the female mice received testosterone, three of the male and three of the female mice received estrogen, three of the male and three of the female mice received both testosterone and estrogen, and three of the male and three of the female mice served as a control group. It was observed that both the male and female times to run the maze for the testosterone group were noticeably faster than the times of the male and female estrogen and control groups after receiving the testosterone and estrogen.

It seems that testosterone and a mixture of testosterone and estrogen increased spatial learning and estrogen decreased the spatial learning ability of both these male and female mice.

EFFICIENCY OF LOCOMOTION IN NATRIX SIPEDON

Piazza, Stephen J., City Honors School, Buffalo, NY 14204;
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Snake slithering is an unusual form of locomotion. It utilizes the waving, undulating motion of a fish, yet takes place on land. The purpose of this study was to determine the energy-efficiency of limbless locomotion in snakes, using the broad-banded water snake (Natrix sipedon). One would hypothesize that limbless locomotion would be more efficient in its use of energy than other types of land locomotion because limbless locomotion does not carry the burden of accelerating or decelerating limbs. Snakes were placed in a resting chamber for 20 minutes, which was followed by a 10-minute run on a treadmill. Runs were conducted at 1 and 2 kilometers per hour. The treadmill run was followed by a 45-minute recovery period. Oxygen consumption was monitored during the resting and recovery periods using an oxygen analyzer. Cost of transport is a standard measurement of efficiency of energy metabolism, in terms of the amount of oxygen used per gram of animal per kilometer travelled. The oxygen consumption data were then used to determine the cost of transport, which was calculated to be .319 ml02/g/km. I have found this value to be unique among all animals studied thus far. My data would indicate that snake locomotion is among the most efficient yet found. To date there are no published studies in this area.

#NOTES ON THE SYMBIOTIC RELATIONSHIP BETWEEN ACROPORA PALMATA AND DOMECIA ACANTHOPHORA

Ruiz, José A., Blanca Malaret High School, Sabana Grande, P.R. 00747;
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Acropora palmata (Lamarck) commonly known as elkhorn coral is a colonial coral which forms tree like structures of flat, expanded branches resembling the horns of a moose. The coral is brownish yellow to cream in color and can be considered a good representative of shallow water corals in caribbean reefs. The genus Acropora harbors a symbiotic crab, Domecia acanthophora (Desbonne and Schrann), which lives in small caves between the branches of the coral. This investigation attempts to study as complete as possible the behavior and feeding habits of the crab as well as the nature of its symbiotic relationship.

Five stations were selected along the southwestern coast of Puerto Rico to carry out the study. At each station the environmental parameters that could exert an affect on the organisms being studied were recorded. Host specificity trials were conducted to test the preference of the crab toward their natural host, eight other corals and a stone. Domecia, preferred A. palmata over all other corals with 81% of preference in an average time of 2:14 minutes. This was followed by A. cervicornis with 66% of preference in 2:33 minutes.

Tests conducted to find out if the crabs locate their hosts in the natural environment using visual cues indicate that the crab appears to be attracted to the coral by visual recognition and that distance is an important factor. Tests conducted to determine if olfaction plays an important part in the location of the host by the crab showed that apparently it does not. Color preference tests revealed the crab is attracted to the same color shown by the host. Feeding habits of the crab were also studied.

The symbiotic association is confirmed as one of a commensal nature.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

#X-RAYS: EFFECTS ON THE OFFSPRING OF MUS MUSCULUS

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The purpose of this experiment is to determine how overexposure of radiation to impregnated mice affects the offspring.

The number of x-rays which penetrate the body when taking a radiograph, is determined by the size of the animal, more specifically, by the density of the tissue being radiographed.

In this experiment eighteen mice were divided into three groups of six; three male, and three female in each. The impregnated females of Group A were exposed to radiation equal to two times the amount used during a normal radiograph. The impregnated females of Group B were exposed to 100 KVP, that is just under four times the amount of radiation for a normal radiograph. Group C was the control.

Three weeks following the experiment these results were observed: Group A had normal births with no apparent defects; in Group B the neonates were either stillborn or died shortly after birth; Group C gave birth normally.

Although there were no obvious defects in the offspring of Group A at birth, effects of the radiation may become evident as maturation continues.

The experimental results could be used in further diagnostic procedures to determine the dangerous effect of nuclear energy and ultimately of nuclear war.

#Second Award - United States Air Force

#POLLUTION: THE EFFECT OF COPPER ON OYSTERS

Barrett, Jennifer, Lauralton Hall, Milford, CT 06460
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The effect of copper pollution on the gill tissue of the Eastern Oyster (Crassostrea virginica), a native to Long Island Sound, was studied. Copper is known to have a negative effect on the survival rate of adults and larvae, shell width, and spawning. In this project the respiration, pumping rate, and gill tissue anatomical structure was examined as a function of copper concentration.

Thirty-two oysters were placed in eight aerated containers of filtered sea water maintained at various concentrations of copper as cupric chloride from zero (control) up to .10 ppm. Each day the oysters were fed 100 ml. of Dunaliella euchlora. The experiment was run in duplicate to insure more reliable results.

Pumping rates were measured using a fluorometer to determine the quantity of food eaten, and by weighing the fecal material in each tray. Gill tissue from the oysters was placed in a respirometer. An SEM was used to observe any anatomical changes in the gills.

The data indicated that the oysters exposed to .10 ppm. copper closed their shells and respired anaerobically, thereby, avoiding contact with the copper. Fecal measurements showed a progressive decrease with increased copper concentration; otherwise, the oysters exposed to the lower concentrations showed no effects of the copper. These observations were also supported by the SEM measurements which showed no visible damage to the gill tissue. Furthermore, the fact that three of the four from the .10 ppm. concentration had a depleted number of algal cells demonstrated a lack of feeding.

#Fourth Award - General Motors ISEF

#WHICH CONCENTRATION OF AGGREGATION PHEROMONES IS MOST EFFECTIVE IN ATTRACTING BLATELLA GERMANICA TO A COMMERCIAL TRAP?

Latta, Chris, South Junior High School, Henderson, KY 42420
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The purpose of this research is to find which concentration of aggregation pheromones is most effective in attracting Blatella germanica to a commercial trap. The hypothesis states that the original concentration of the spot pheromone will attract more B. germanica to the trap because it has the highest concentration of pheromone. Populations of field collected B. germanica were raised in a 5 gallon plastic container equipped with "roach condominiums." Two pheromones were used, spot, and spot-fecal combination. Four concentrations of each pheromone were used, the original concentration, 75%, 50%, and 25%. These concentrations were prepared by mixing a given amount of spot soaked and fecal material soaked in given amounts of methanol. Cardboard circles were soaked in the pheromone solutions and then placed in Black Flag Roach Motels except for the control which was empty. The traps were then placed in four locations with known cockroach populations in areas prone to roach infestation. Traps were rotated in a given pattern. All data collected for 20 days was tabulated and analyzed. An analysis of variance was applied to the data and an F-ratio of 3.793 with 3, 4 degrees of freedom was obtained. This gives a .89 significance and the null hypothesis is rejected with reservation. The difference within the levels of concentration appears numerically to be the result of the 75% concentration. In conclusion, the 75% appears numerically to be the most effective concentration of aggregation pheromone in attracting B. germanica to a commercial trap.

#First Award - United States Army

The Effects of Radiant Energy in the Form of Light on the Dugesia tigrina

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In this project, a sample size of twenty Dugesia tigrina (brown planarians were placed in three environmental situations dealing with radiant energy in the form of light. The planarians were cut in half under a microscope and placed in dishes in these situations:

1. Normal conditions (12 hours in light; 12 hours in darkness)
2. Constant light
3. Constant darkness

The time that it took the planarians to regenerate was recorded, averaged, and graphed. The planarians under normal conditions took an average of 8.8 days to regenerate. Those in constant light took 10.4 days. And the ones in constant darkness took 7.4 days. It is therefore concluded that the less light a planarian receives, the faster it will regenerate.

INVESTIGATIONS OF NICOTINE INDUCED MUTATIONS IN SEX-LINKED DROSOPHILA MELANOGASTER.

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Dr. Muller won a Nobel prize fro his work with radiation in Drosphila melanogaster. In this investigation some of Dr. Muller's procedures were followed, except nicotine was used instead of radiation. This investigation required ninety days of continual observation. In the first investigation sex-linkage was hypothesized. This hypothesis was proven correct by the data from the first generation backcross in investigation two.
Investigations one and two involved wild and white eyed pure culture strains, utilizing virgin females. In investigation, three white eyed virgin crossed were made with media that contained different concentrations of nicotine in percentages of 10%, 1%, .01%, .001%, .0001%. The control contained no nicotine. A Chi-square statistical analysis was made on each group. Data indicated that inferior abdomen conditions occured more often in female than male. The male counts were well below the expected ratios. There were also increased numbers of intermediate alleles. Inferior or shrunken abdomens were found extensively in the high concentrations of nicotine. The Chi-square indicates that chance happenings would not occur 95% of the time. Chromosome mapping indicated that the mutations would have to have been sex-linked on the X chromosome. Induced nicotine could have attributed to the mutations on the sex-chromosomes of Drosophila melanogaster.

#OCCURRENCE OF ACARINA ON LEPIDOPTERA IN THE PROVINCE OF UPPLAND, SWEDEN, ESPECIALLY AMONG NOCTUIDS

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Regarding Acarids and their relations to the insects, very little is known, as well as in the Swedish Acari fauna in general. In European literature the occurrence of Acarids on Lepidoptera is only mentioned as passing observations, and in Sweden the subject is completely unknown.

During 1983 and 1984, 3257 Macrolepidopterans have been examined with regard to the occurrence of Acarina of this order. 126 larvae of the Erythraeid Leptus ignotus (Oudemans) were found during the period of 27/7-2/9. This ectoparasitic, possibly also foretic larva, is feeding on Lepidoptera for at least six days. It mainly attacks the legs, but also wings, eyes, antennae, abdomen and genitalia. The larva increases rapidly in size as an effect of the haemolymph holding. Accordingly the length varies between 0.470 mm and 0.830 mm.

The average frequency of Leptus-larvae/attacked Noctuid is low, 1.8. This low figure might be a result of natural selection. A great number of ectoparasites may weaken the host severely, and the parasites might therefore be stunted in their further development. Contrary to some foretic Acarids, the ectoparasites must spread themselves after hatching in order to avoid crowded hosts.

The affecting frequency varies considerably among different species. For example, Leptus-larvae appear at least sixtimes more often attached on Leucania impura Hb. than on Hydraecia fucosa Frr. The host's choice of resting place during daytime is considered to be the cause of differences in frequency.

#Second Award - General Motors ISEF

#DESCRIPTION OF A NEW ASTOMATE CILIATE (HAPTOPHRYDAE, CEPEDE 1923): A SYMBIONT OF THE PULMONATE GASTROPOD CERION STRIATELLUM SOWERBY IN SOUTHWESTERN PUERTO RICO

Vega, Julio V., Lola R. de Tio High School, San Germán, P.R. 00753; Bo. Cotto, Carr. 347 KM 1.7, San Germán, P.R. 00753.

Cerion striatellum Sowerby, 1875 is a gastropod found in the xerophytic coast of southwestern Puerto Rico. It lives adhered rocks, tree trunks, cactus and among grass in the dry season. C. striatellum is limited to the arid Region of the island. It harbors a symbiotic protozoan which represents a new species.

The study involves 5 stations, 4 of which are positive for the ciliate. One hundred snails were examined per station to determine indicence of infection which turned out to be very high for Tamarindo with 88% and 79 ciliates/snail.

New ciliate belongs to Order: Astomata and Family: Haptophrydae. It has been named Proclausicola portoricensis n.sp. It is 479.01u in length and 68.53 in width. It shows 28 contractile vacuoles, a macronucleus, no micronucleus and the body is covered by 53 ciliary meridians dorsally. The anterior part shows a bald band. The cytoplasm is full of granules. Differential staining has shown the presence of lipids and polysaccharides. Reproduction is by binary fussion and shows a rare type of pairing without interchange of nuclear material.

Statistical tests showed a significant difference in length, width and weight of snails in positive stations vs. negative station in Puerto Real. Determination of organic matter and mineral content was higher in negative station with respect to positive stations, suggesting symbiont is responsible for the difference. Transfer of infection from an infected to non infected snail was not possible.

There is a clear symbiotic relationship between gastropod and ciliate. It seems to be a commensal one since it does not seem to harm the host yet all known members of the other are parasitic.

#Fourth Award - General Motors ISEF

A BIOLOGICAL STUDY OF ORTHOCRICUS ARBOREUS

Torres, Yadira, Lola R. de Tio High School, San Germán, P.R. 00753; Carr. 348 Km. 15.4 Rosario Alto, San Germán, P.R. 00753.

Orthocricus arboreus arboreus (Saussure, 1859) is a small to large millipede characterized by the shape of the male gonopods which is common throughout the Caribbean. In Pueto Rico it is quite common in the southwestern part of the island. Very little is known of the biology of this millipede besides the fact that it has several subspecies. This investigation represents the beginning of a study designed to improve our knowledge of this species.

The millipedes studied in this work all come from one station in Cain Bajo, San Germán, P.R. The environmental parameters under which it is found include a relative humidity of 62%, a light intensity of 380 foot candles, a substrate temperature of 78°F, an air temperature of 28°C and a wind velocity of 10 mph.

Measurements of the millipede were determined for length and width. The number of legs and segments were recorded as well as their weight. Standard deviations for all measurements were taken.

Several aspects of the biology of this species have been studied such as velocity, geotaxic response, height preference, preference for light and darkness, movement patterns and relative humidity preference.

Parasitological study revealed the presence of mites on the surface of the organism. Nematodes have been found on the hindgut of this species. Several different forms have been found and infection seems to be very high. This particular aspect is under study now.

NATURAL VS. PROCESSED FEED

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The problem in this experiment was to find out which feed is better, natural or processed. The hypothesis was that the animals fed processed would gain better in gross weight and weigh more after cleaning. The experiment uses two sets of rabbits. Each set was the same color, sex, and from the same litter. The animals on processed feed were fed pelleted feed. The animals on natural feed were fed oats, corn, hay, and greens. The animals on processed feed were definitely heavier than the animals on natural feed. The weights after cleaning were about the same. The animals on processed feed had very excessive fat and the livers of these animals were also about one-third larger. These factors may have accounted for the greater difference in gross to cleaned weight. Overall, there is very little difference in the performance of the natural and the processed feeds. The processed feed cost about five hundred percent more during the seventeen week test period. The processed feed did perform better in gross weight, but in the weight after cleaning there was virtually no difference.

X RADIATION AND REGENERATION IN DUGESIA TIGRINA

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The purpose of this experimentation was to observe the effects of X radiation on the regenerative abilities of the brown planaria, Dugesia tigrina.

Four separate experiments were conducted, each of which was then repeated. In these, two different factors - amount of radiation and the type of cut were identified and tested in combination. In each experiment, three groups of planaria were exposed to different amounts of radiation, while one served as a control and was not irradiated. The planaria were individually observed under a stereomicroscope and were given either a transverse or longitudinal cut. They were observed again every 48 hours in the average 336 hour regenerative period.

At the end of this period, the planaria were observed as to whether or not they had completely regenerated. The results suggested that (1) X radiation can damage regenerating tissues, and (2) the type of cut made is generally insignificant as to how the planaria regenerate.

The data clearly demonstrated the damaging effect of X radiation in rapidly regenerating tissues.

THE EFFECTS OF MAGNETISM ON THE REGENERATION PROCESS OF PLANARIA

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Magnetic fields have aided in healing human bones. Will magnetic fields also help planarian regenerate faster?

Six equal sized worms were cut in two. Two petri dishes were labeled "Magnet", two "5 inches", and two "Control". The tails were placed in the dishes. The "Magnet" worms were placed next to the magnet, the "5 inch" worms five inches from the magnet. The "Control" worms were out of the magnetic field.

The worms nearer the magnet regenerated faster for the first two days, from the third day, no differences were noticed.

FOOD PREFERENCES OF WILD BIRDS

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The purpose of my project is to find out what kind of seed in commercial bird food mix is preferred by the following species of wild birds in central Arkansas: Red-bellied Woodpecker (Melanerpes carolinus), Blue Jay (Cyanocitta cristata), Tufted Titmouse (Parus bicolor), Carolina Chickadee (Parus carolinensis), Northern Cardinal (Cardinalis cardinalis), Pine Siskin (Carduelis pinus), American Goldfinch (Carduelis tristis), Dark-eyed Junco (Junco hyemalis), and the White-throated Sparrow (Zonotrichia albicollis).

A feeder was constructed to hold the four types of seeds found in commercial bird food. These seeds are millet, milo, wheat, and sunflower. Two brands were used, GTA and Safeway. After birds had become attracted to the feeder, observations were started. An observation notebook was kept and sightings were recorded daily. From tohals made from these observations, food preferences were decided toward a type of seed.

These preferences were shown toward either millet, milo, wheat, or sunflower seeds. Sunflower was observed to be the most preferred food of the red-bellied woodpecker, blue jay, tufted titmouse, carolina chickadee, american goldfinch, and pine siskin. The northern cardinal preferred both sunflower and millet. Millet was also observed to be the prime food of the dark-eyed junco and the white-throated sparrow. Milo was also liked by these two birds but not as much as millet.

THE GALL FORMERS OF CHRYSOTHAMNUS SSP. A CONTINUING STUDY

HEPPLER, HEATHER LYNN., Dixie High School, St. George, Utah 84770
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The project this year centered on population studies, further identification of the inhabitants of the gall community, and production of the galls without the actual presence of the Tephritid fly which I had previously identified as the causative organism of the gall. Three distinct gall forms were found on the Chrysothamnus shrub this year. A large white gall, a large greenish-purple gall, and a small brown gall. They were given the names "woolly", "spiny", and "cone" respectively. Previous work had established the Tephritid as the "woolly" gall insect and this year it was also found to cause the "spiny" gall form. Two other Diptera (midges) and two Hymenoptera (Cleigids) were frequently found in the "woolly" and "spiny" galls. In some cases they just shared the gall with the Tephritid larva but sometimes they parasitized the larvae.

A plastic isolation chamber was developed so that parts of the stem could be studied in situ without interference from outside factors. Using this chamber work was done using extracts from Tephritid larvae and pupae. These were injected into the stems of the plant to see if galls would grow without the actual insect being present. Both types of extracts initiated gall growth. Distilled water injections had no effect. Unless injections were repeated the gall would stop forming. This agrees with data gathered which indicate that if the pupa is destroyed by parasites during the formation of the gall, the gall will be smaller than normal.

Work is currently being done on the genetics of the Tephritids that can causes both "woolly" and "spiny" galls. If one species causes both galls then the gall form is genetically controlled.

#First Award - General Motors ISEF

THE DEVELOPMENT OF MICROPHTHALMIA WITH COLOBOMA IN THE EYE OF THE AUSTRALIAN SHEPHERD DOG, CANIS FAMILIARIS

Nadenik, Scott A., Seabreeze High School, Daytona Beach, FL 32018; 758 Knollview Blvd., Ormond Beach, FL 32074.

PURPOSE: This research is a comparitive, morphologic study of anomalous development in the eye of the Australian Shepherd dog, canis familiaris. The inherited aberrations, Microphthalmia with Coloboma, are the reasons for which the Australian Shepherd pup is born without the ability to see and in some cases without the ability to hear. By comparing the histological development, we hope to gain a higher understanding of the processes and evolvement of the defective eye.

PROCEDURE: The defective and normal eye tissue had been obtained 3 years prior to this particular research project. The postnatal eyes were obtained after euthanasia and put into a fixative. The prenatal eyes were obtained after caesarean sections, and the whole fetuses were then put into a fixative. The eye samples, once embedded in paraffin or plastic, were sectioned at 5 microns and 1 micron respectively. Employing the use of light microscopy and electron microscopy, the normal and defective eye tissue samples were compared according to chronological order.

RESULTS: In comparison to the distinctly clear structures of the normal eye tissue, the defective tissue showed signs of degeneration, especially in the retina. The Shepherd dog eyes had little or no melanocytes(pigment producing cells). Staphylomas were also present in regions where there was little or no choroid present.

CONCLUSIONS: The migration of the different germ layers is abnormal. The cells are not differentiating into melanocytes. Melanin, therefore, may possibly be needed for the different germ layers(such as mesoderm) to react and differentiate properly in order to form the correct optic components.

#First Award - Eastman Kodak Company

Third Award - American Optometric Association and the Auxiliary to the American Optometric Association

Fourth Award - General Motors ISEF

EFFECTS OF THYROID HORMONE ON THREE MEMBERS OF THE ANIMAL KINGDOM

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The purpose of this science fair project is first to observe the normal life cycle and/or metamorphosis of fruit flies, tadpoles and chick embryos; and second, to qualitatively and quantitatively observe the effects of thyroid and antithyroid compounds on the life cycles and metamorphoses of these three organisms. Measurements and descriptions will be used to characterize the qualitative aspects of the experiment. A liquid scintillation counter will be used to measure the quantity of circulating thyroid hormone. Research shows that thyroid hormones and inhibitors affect the rate of development and metamorphosis of organisms throughout the animal kingdom. This fact even holds for organisms such as Drosophila, that do not have a thyroid gland. Drosophila, however, do have iodinated proteins in their systems. These proteins are considered to be the precursors of thyroid hormone. This study indicated that increased levels of thyroid hormone caused a marked decrease in the time required for fruit flies to mature, while the antithyroid compounds caused a marked increase in the time required for this process. In tadpoles, increased levels of circulating thyroid hormone caused a marked decrease in the time of metamorphosis. These levels appear to affect only the development time. In contrast, chick embryos are extremely sensitive to even the slightest increase in circulating thyroid hormones. An increase or decrease in thyroid hormones appears to affect the hatch, that is, the number of viable embryos.

GAME BIRD V/S CHICK STARTER WITH ADDITIVES

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The purpose is to see if cooking oil really aids in a rapid growth of poultry. Also to see how much marigold blooms increase the pigment through poultry's body. The reason for this is to see if additives can make a diffense. The reason Im tring to improve these feeds is because last year I tested these two types of feeds and Game Bird out grow Chick Starter, more expensive.

The procedure was that the chicks were fed twice aday and watered. The Chick Starter chicks recieved 3/4 cup of cooking oil, and 50 marigold blooms which would work out two blooms each. Pictures were taken at the end of my studies of the size and the pigment in the shanks. At the end of the period I came up with these results. Chick Starter chicks weighed 4.1 lbs., while Game Bird weighed 2.15 lbs., an difference of 1.2 lbs.

The cost of Game Bird was $10.35 for 50 lbs. Chick Starter costed only $5.10, cooking oil $1.79, a pack of marigold seeds .60¢, total of $7.49. The difference of $2.86. To raise one chick to this weight is .95¢ for Game Bird, and for Chick Starter .61¢.

#MODE OF INHERITANCE OF STRAIN SPECIFIC VARIATIONS IN FOLIAL PATTERNS OF THE MOUSE CEREBELLUM

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A study done by Minoru Inouye (1980) revealed that the morphological variations in the folial patterns of the mouse cerebellum were strain specific in mice and had an intimate genetic control. Using the inbred strains, BALB/cByJ and C57BL/6J, the purpose of this research is to determine the mode of inheritance of this strain difference. To examine and compare the cerebellums of the mice, they were anesthetised with .5ml of chlorohydrate and perfused intracardially with 10% formalin. The cerebellum was excised from the cerebellar peduncles, sliced into 2mm mid-sagittal slices, and the profiles of the cerebellum were drawn with the aid of a projecting microscope. The cerebellum was examined and compared in BALB/cByJ X C57BL/6J F1 and F2 hybrids and CXB series of recombinant inbred strains (derived from 20 generations of inbreeding BALB/c and C57BL/6) to the parent generation. The cerebellum was classified as "BALB/c-like" if it had 2 declives, 2 uvula vermis, or a lingula or as "BL/6-like" if it had 1 declive, and/or 1 uvula vermis; BL/6 hasn't a lingula. In both male and female CB6 & B6C F1 hybrids the folial patterns were BALB/c-like. In 7 of the 11 F2 hybrids the folial patterns were BALB/c-like, the remaining BL/6-like. Of the recombiant inbred strains, 5 (CXBD, CXBE, CXBH, and CXBJ) had BALB/c-like folial patterns and 2 (CXBI and CXBK) had BL6-like folial patterns. These results are consistent with inheritance by means of autosomal dominant or (semi-dominant) gene. The strain distribution pattern obtained from the CXB series of the BI strain is not concordant with any of the approximately 200 strain differences so far reported for the two progenitor strains, BALB/c and C57BL/6. This is conclusive proof that the BALB/c folial pattern of the cerebellum is not congenic.

#First Award - American Veterinary Medical Association
First Award - General Motors ISEF

#CONTROL OF RETICULITERMES FLAVIPES AND COPTOTERMES FORMOSANUS THROUGH THE UTILIZATION OF COMMON HOUSEHOLD SUBSTANCES

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106 45th Street, Gulfport, MS 39501.

Purpose: To determine if common natural household items (e. g., garlic, oranges, and tobacco) would eliminate R. flavipes and C. formosanus or discourage feeding on the treated wood.

Procedure: Wooden blocks were impregnated with solutions of garlic, oranges, tobacco, and water(control). Forced feedings of 2 different time lengths and 2 different species were performed. At the end of four and eight weeks, the test set-ups were broken down and termite mortality and wood consumption were determined.

Results: The results indicate that garlic provides the best control. Also, the orange treatment prevented the termites from consuming as much wood as the control group did. The tobacco treatment was not successful.

Conclusions: Garlic is an effective control device for both R. flavipes and C. formosanus. Garlic will kill R. flavipes and prevent consumption by C. formosanus. Oranges deter consumption by both R. flavipes and C. formosanus. The level of tobacco used had no effect on either species; possibly, a higher concentration might produce better results. However, for a strong conclusion to be drawn, this experiment would have to be repeated many times and much more extensively with more control over the variables to determine the long-range effects and possible break downs of the variables.

#Third Award - General Motors ISEF

#ANT-AGNOSTIC PHEROMONES

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The idea behind this project was to discover whether a pheromone might actually be a determining factor in the overall behavior of a certain species. The primary question that I asked myself before performing the experiment was to what degree would the behavior of harvester ants be affected if I were to "fiddle" with their system of communicating. To test for this question I obtained pheromones from ants living in two particular colonies. I then proceeded by using these pheromones in various situations such as with other harvester ants and inanimate objects. I concluded from numerous tests that pheromones indeed play a major role in controlling harvester ant behavior.

This science fair project is another piece to the pheromone puzzle. Previous experiments and research have proven that pheromones actually do exist and play key roles in animal and human behavior. Many future tests will be completed in this area and they will reveal the powers of those "ant-agonistic pheromones."

#First Award - General Motors ISEF
Second Award - American Psychological Association

HOW DIFFERENT GASES AFFECT BLOOD CLOTTING TIME ON MUS MUSCULUS

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Brady Route, Box 13, Mason, TX 76856.

The effects of carbon monoxide, carbon dioxide, and oxygen were tested on Mus musculus' blood clotting time as compared to a control. In order to expose Mus musculus to each of the four gases used, a special chamber from a plastic container was designed and used. After the Mus musculus had been exposed, the tip of its tail was cut with a pair of scissors, and transferred the blood directly onto a slide. Wright's blood stain was used, to help determine the clotting effect on blood cells collected.

The oxygen gas group clotted the blood in the least amount of time with an average of 9.5 minutes. The control had the next fastest clotting time with an average of 12.8 minutes. The carbon dioxide and carbon monoxide were next with averages of 17.1 minutes and 21.3 minutes respectively. The volume of clotted blood was greater corresponding with the same order of time.

With the data obtained from several trials, the oxygen gas groups clotted the blood the fastest because red corpuscles transport oxygen from the lungs to all parts of the body. This is possible because of the presence of hemoglobin, which oxygen combines with from the various gases tested. In oxygen-rich surroundings, hemoglobin unites with oxygen to form a compound called oxyhemoglobin.

In surroundings low in oxygen, oxyhemoglobin gives up its oxygen readily. Hemoglobin carries oxygen from the lungs to all the body cells. This is why the oxygen clotted the blood the fastest. Data applications will be made in a new project using various gases, in a chamber system, hoping to find a method of effecting a clotting technique that may have application in some blood diseases.

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